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Picking leaves in a tobacco-field covered with a canopy of cheese-cloth.

THE TOBACCO INDUSTRY IN CUBA. See page 304.

Food Value of Alfalfa Used as a Table Vegetable

German War Foods that Possess Peace-time Possibilities

By Dr. G. Haberlandt

The supply of food in the world is still so far from normal that the following article by the world-famed German botanist, Dr. G. Haberlandt, taken from "Die Naturwissenschraften" (Berlin), will be of widespread interest, in spite of the fact that it was written while Germany's food supply still felt the pinch of war.—EDITOR.

THE vegetarian system of diet which at the present time (June, 1916) plays a much greater part in the German Empire and in Austria-Hungary than in times of peace must rely upon vegetables to a great extent, to supply our daily need of albumen. . . . this requirement, however, appears to be difficult to fulfill, since the protein contained in the ordinary sorts of vegetables (leaf and stem vegetables) is rather scanty, as is likewise the case in general with organic nitrogen compounds. This percentage of "nitrogenous substances" is estimated by J. Koenig[1] to average as follows: 1.83 per cent for both white cabbage and red cabbage, 3.99 per cent for winter cabbage, 4.83 for Brussels sprouts, 2.48 for cauliflower, 3.71 for spinach, 1.95 for asparagus. In all these cases it should be noted that only a part of the so-called nitrogenous substances—though usually by far the greater part—consists of protein, the remainder being composed of various amides (amino-acids, particularly asparagin) . . . it is of great importance for the popular nutrition that we should make the greatest use possible of the other sources of albumen afforded by the plant kingdom, previous to the coming of the next harvest and to the increase in the consumption of meat which cannot be looked for until October or November. This means that we must turn to the vegetative organs of plants, i. e., the stalks and leaves, which are still richer in albumen than the most albuminous vegetables produced in Germany and which can easily and cheaply be raised in very large quantities, and whose enjoyment is unattended by danger to health. . . .

Vegetative organs which answer these conditions are found in the *foliage of various leguminous plants*, especially alfalfa and a few other widely raised varieties of clover.

Alfalfa (*Medicago sativa L.*) is widely cultivated throughout all Europe with the exception of the Arctic regions, as well as in Asia Minor. Thanks to its rapid growth and to its great power of assimilation it can be cut three or four times a year in Germany. Dietrich and Koenig (Zusammensetzung u. Verdaulichkeit d. Futtermittel, 2 ed. Vol. I.) give as the average content in nitrogenous substances of young plants a few inches in height, 6.25 per cent, and at the beginning of the flowering season, 4.56 per cent. It is especially noteworthy that the leaves are much richer in nitrogen than the stalks. The former, harvested on April 24th contained 8.1 per cent and the latter only 2.1 per cent, while after the second cutting on May 22nd these values were 8.8 per cent and 3.3 per cent respectively. Thus if we compare the leaves of alfalfa with those of spinach and of the members of the cabbage family which are richest in albumen we find that the content in nitrogenous substances of the alfalfa foliage is about double that of the vegetables mentioned.

The relatively large albumen content of alfalfa leaves can be readily demonstrated to the eye by the well known Millon reagent or other tests for albumen. According to the process recommended by Molisch[2] the leaf is placed in boiling water for one minute and the chlorophyl is then extracted in warm alcohol until the leaf appears to be white; if it be then placed in freshly prepared Millon reagent after the lapse of a few hours it exhibits a *dark brick red color;* fully developed leaves exhibit a somewhat more intensive color than young undeveloped ones. A leaf of red cabbage treated in the same manner is much less intensively colored than the leaf of alfalfa in spite of its much greater thickness. Spinach leaves are colored a much brighter red.

The stems of alfalfa are not suitable for human food, not only on account of their comparatively small nitrogen content but particularly because they are rich in bast and wood fibres. An anatomical examination of the fully developed stem shows that the numerous fibro-vascular bundles exhibit rather strong envelopes of bast whose middle lamellae have to some degree been lignified. . . . The foliage leaves are provided on both sides with a delicate-walled epidermis. The epidermis or outer walls are only 0.0025 m. thick and have a very tender cuticula. The high palisade cells' layer as well as the densely constructed spongy parenchyma are particularly rich in grains of chlorophyl which probably formed a primary condition governing the amount of albumen in the leaves. As Molisch recently showed both by macro-chemical and micro-chemical methods the principal mass of the albumen of the leaves resides in the grains of chlorophyl.

It is a very favorable circumstance for the edibility of the leaves that the mid rib of the leaflet exhibits a mechanical envelop only upon the underside of the bundle of vessels and that this does not consist of bast cells but only out of moderately thickened collenchymatous cells whose walls, as we know, are not lignified. In the secondary nerves the bundles of vessels, it is true, are provided on both sides with slightly lignified envelops of bast; however, these consist on the average of only 4 to 7 cells on the upper side and 7 to 10 cells on the lower side. Consequently the entire leaf may be regarded as being poor in mechanical fibres.

Upon the under side of the leaf there appear, evenly distributed, a scanty number of pointed hairs about 1 mm. long and 0.012 mm. thick and having greatly thickened cell walls; which aside from that of the tender cuticula, which bears small knots, consist of pure cellulose and are therefore, neither lignified nor cutified. It is quite impossible for these soft and flexible little hairs to affect the digestibility of the alfalfa leaves.

. . . The important question is as to the content of indigestible crude fibres. "Crude fibres" is the term commonly applied in chemical analysis to the difficultly soluble celluloses, especially the lignified and cutified ("corkified") cell walls. Dietrich and Koenig state the average content of crude fibre in young alfalfa plants about four inches in height, to be 4.36 per cent, while in plants ready to bloom or beginning to bloom the content is 6.82 per cent. Leaves harvested April 24th contained 4.1 per cent while those of the second cutting on the 22nd of May contained 6.1 per cent, and the stems contained only 3.9 per cent and 5.4 per cent respectively of crude fibres. The last figures, however, cannot possibly be right since anatomical examination shows that the stems, aside from the extremely young portions, contain a much greater number of fibres (bast and libriform cells) than the leaves. On this account I tested alfalfa plants harvested June 2nd for their crude fibre content by the *Weender* method, employing for the purpose of analysis the ends of the twigs (which were 5 cm. long) with their leaves and flower buds as well as *all* leaf sprays of the stems concerned—i. e., those organs and parts of organs which are the only ones having nutritive value. I found a crude fibre content of 4.52 per cent. This is considerably more than the crude fibre content in winter cabbage (1.88 per cent), red cabbage (1.29 per cent), spinach (0.94 per cent) and asparagus (1.15 per cent). Since we are in general concerned here with elements in the form of fibres (bast cells and libriform cells, tracheides), this disadvantage can be remedied to a certain degree during the preparation by passing the leaves and stems, after they have been boiled and cut up, through a fine hair-sieve.

With respect to the so-called *non-nitrogenous extractive matters*, which consist essentially of sugar, starch, hemi-celluloses and pentosenes the figures of various authorities differ greatly, which is readily comprehended when we remember that the foliage is entirely lacking in starch in the early morning and very rich in starch towards evening. According to Dietrich and Koenig the young plants contain from 4.2 per cent to 8.42 per cent of non-nitrogenous extractive substances; the leaves (whose content in nitrogenous substances and crude fibres was given above) contain 8.5 per cent of the nitrogen-free extractives. Winter cabbage contains, according to Koenig, 11.63 per cent, Brussels sprouts 6.22 per cent, red cabbage 5.86 per cent, spinach 3.61 per cent, asparagus 2.4 per cent, of such extractives, including sugar. We see, therefore, that in this respect also alfalfa surpasses most of our vegetables. Before and at the beginning of the blossoming season the average content of *crude fat* is 0.83 per cent, in other words, almost as much as in winter cabbage (0.90 per cent) and more than in Brussels sprouts (0.46 per cent), red cabbage (0.19 per cent), spinach (0.50 per cent) or asparagus (0.14 per cent).

A few words should be said regarding the *method of preparing* this new vegetable. At the beginning of June 25 stalks of alfalfa were cut from the bed in the grounds of the Institute of Plant Physiology at the University of Berlin, each stalk being cut at a height of about 10 cm. above ground. The length of the stalk was from 58 to 85 cm. and the total weight was 322 gr. They possessed altogether 164 side twigs of more than 2 cm. in length. For preparation as a vegetable the points of the main stalk and the side twigs up to 5 cm. in length together with all the leaves (without the leaf stem) were employed; their weight amounted to 128 gr., i. e., nearly 40 per cent of the total weight. As proved by microscopic examination young stalks of the length mentioned can be used without difficulty since the bast envelop of the bundles of vessels at a distance of 5 cm. from the top of the plant is still in the collenchymatous stage, i. e. not lignified while a libriform ring has not yet been formed. The leaves and ends of the stems were boiled in several waters in order to remove the somewhat bitter taste and were then accurately weighed, pressed through a hair sieve, and dressed in the usual manner in which spinach is prepared. A microscopic investigation showed a surprisingly extensive breaking down of the tissues, especially of the palisade parenchyma and spongy parenchyma in the separate cells. Consequently, the enzymes which are active in digestion can penetrate with ease into the interior of the cells through the tender cell walls.

This alfalfa used as a vegetable had a slightly bitter but agreeable taste, reminding me of "Kochsalat" ["boiled salad"], which is commonly eaten and much liked in South Germany and particularly in Austria. Everyone who tasted it agreed with Leunis, who writes in his "Synopsis Der Pflanzenkunde" (Synopsis of Information Concerning Plants) that alfalfa is recommended as a savory spring vegetable.

In the German Empire in 1893 and 1900 about 160,000 hectars were planted with vegetables[3] in the open fields. If we accept the estimate of A. Schulte that an equal number of vegetables were planted in kitchen gardens and orchards, then a total area of 250,000 hectars in the German Empire was planted bles. According to the same author (a. a. O. S. 44) 251,000 hectars in the German empire were planted with alfalfa, i. e. an area equal to 78 per cent of that devoted to vegetables. It is obvious from these figurges what an enormous addition of comparatively cheap and nutritious food would be available for the new nutrition of the populace if only a fraction of the alfalfa harvest were employed for human food. Whether and how this could be economically carried out lies outside my domain. It may be supposed, however, that in times of scarcity many difficulties which might normally interfere would be overcome.

The question remains as to whether the leaves and stems of the other leguminous plants can be used as vegetables. This question may be unconditionally answered in the affirmative as regards the other kinds of *Medicago* (*M. falcata L.*, Swedish or yellow alfalfa, *M. media Pers.*, great sand alfalfa, *M. Lupulina*, hops alfalfa). In the case of *M. lupulina* at the beginning of the blossoming season upon unfertilized farm land there is a content of 4.48 per cent of nitrogenous substances while there is 5.62 per cent in the blossoms

(*Concluded on Page* 312)

[1] J. Koenig, Die menschlichen Nahrumgs—und Genussmittel Bd. I. 4 Aufl., Berlin 1904 (Human Foods and Condiments, Bd. I, 4th edition, Berlin 1904).

[2] H. Molisch, Die Eiweissproben, makroskopisch angewendet auf Pflanzen, Zts. f. Bot., Jahrg. 8, 1916, heft 2 (Albumen Tests Macroscopically applied to Plants. Journal of Botany, eighth year 1916 No. 2.

[3] A. Schulte im Hofe, die Welterzeugung von Lebensmittel und Rohstoffen usw., Beihefte zum Tropenpflanzer Bd. XVI, Nr. 1/2, 1916, S. 13 (The World Yield of Food and Raw Materials, etc., Supplement Concerning Tropical Plants, Vol. XVI No. 1/2, 1916, page 13.)

Rhythmic Crystallization

Some New Examples Intermittent Precipitation

By Raphael Ed. Liesegang

Translated for the SCIENTIFIC AMERICAN SUPPLEMENT from *Die Naturwissenschaften* (Berlin).

WHEN a layer of gelatine which has congealed on a glass plate is allowed to dry thoroughly it first loses the water it contains at the edges. If the gelatine contains a solution of some salt it is at the edges that this first reaches such a degree of super-saturation that the salt necessarily begins to separate out.

When this separation occurs in crystalline form there are three possible ways in which it may be distributed. In the first case single crystals, separated from each other and irregularly distributed, make their appearance, as for example in the deposit of sodium chloride. In the second case lines or "branches" of crystals extend from the edge towards the middle of the gelatine layer. The double salt of potassium chromate usually separates out in this manner. The third method of separation has been termed "rhythmic crystallization." In this plan there appear a few or a considerable number of strips of crystals arranged parallel to the edge and at comparatively regular distances apart. These are separated from each other by zones which are free of crystals. In some instances, however, which may still be classed under this head, these zones are merely poor in crystals rather than entirely lacking in them. These cases present an intermediate or transition form.

Occasion is furnished for the present article by reason of the discovery by E. Küster[1] of several new examples of rhythmic crystallization.

Hitherto observations have been principally made with solutions of tri-sodium-phosphate. First a ten per cent gelatine solution is spread upon a glass plate and allowed to congeal. Then a solution of the phosphate (running as high as 10 per cent) is spread upon this sheet of gelatine, or else the phosphate solution is placed upon it in the form of drops. When this is now allowed to dry out slowly at the temperature of the room, bands composed of crystals are formed.[2] In one case 15 of these bands were counted within the space of a single centimeter. In other cases the intervals between the ribbons of crystals are much greater. In the experiments in which drops are allowed to fall upon the gelatine sheet it is noteworthy that the rings of crystals often lie somewhat to one side of the borders of the original drop. This shows that the salt had time to become somewhat diffused in the layer of gelatine.

The explanation of such superficial formation of bands of crystals is as follows. Before the first crystals were formed at the outermost edge there was present at this place a zone of super-saturated salt solution. As the degree of concentration increased a spontaneous deposit of the salt necessarily occurred. These rows of crystals acted as a nucleus upon the super-saturated solution in their vicinity, i. e. the latter diffused towards the crystals and increased the size of the latter. In this manner an area poor in salt content was produced. As the loss of water proceeded this area became super-saturated in its turn. Accordingly the impoverishment in salt content became still more marked through the traveling towards the nucleus. Finally, however, the power of travel in this area ceases entirely because of the fact that it is entirely dried out. In the meantime, at a certain distance from the first row of crystals, the salt solution reaches such a degree of super-saturation, that the separating out of the salt begins spontaneously to occur once more. This row of crystals grows just as the first one did, and the process is repeated indefinitely.

The more abrupt the precipitation in the salt-poor areas, the closer together the bands of crystals. Since the first spontaneous deposit of crystals occurs very suddenly, while their increase in size through the diffusion referred to takes place more slowly, each band may exhibit a very different aspect as regards its outer and its inner side respectively, i. e. dense aggregates of small crystals on the outer side and larger crystals on the inner side.

Among the rhythmic crystallizations upon sheets of gelatine those obtained with ferrosulphate are especially worthy of note because the crystalline form is particularly well developed. A marked contrast to this is furnished by potassium ferrocyanide with its singularly twisted lines exhibiting knotty protuberances. Ammonium sulphate, upon being examined between crossed Nichol prisms presented a zone-like arrangement of the doubly refractive particles. With copper sulphate parallel bands only 1/100 of a millimeter apart were exhibited in one case. (Hauswald has also observed this phenomenon in the crystallizing out of this salt upon glass.) In other cases a very singular trellis-work was produced. Küster is right in emphasizing the fact that the last phenomenon, as well as some others, needs to be explained.

In the case of "ice-flowers" we are concerned not with a deposit because of the evaporation of water, but with one due to the freezing of the water itself. These are readily produced in the banded form by putting the glass plates covered with sheets of gelatine outdoors when there are a few degrees of frost.[3] In this case the rhythmic crystallization exhibits various methods of formation. Sometimes there are large surfaces covered with parallel lines, which run from 10 to 15 in a centimeter. Another time there will be seen smaller groups of concentric rings with intervals of the same size. In this case the rhythm is doubtless determined by processes in the system itself. But it is also possible for forms of sphero-crystalline aspect to occur,[4] which within a radius of about 20 cm. exhibit fewer regular deposits. It is doubtful, however, whether these properly belong to the processes described here, since they are readily produced by slight external variations of temperature.

It must be especially noted that all these observations concern preparations which are developed superficially. For it is by no means certain that the same forms would be produced by the evaporation or the freezing in a three-dimensional example. At any rate no experiments along this line have as yet been made known. On this account some caution is called for before we agree with Küster[5] to accept, on account of its simpler manner of proceeding, the rhythmic crystallizing out of tri-sodium-phosphate as a general example in place of the rhythmic precipitation which occurs in the new formation of silver chromate. In the case of the latter and of many other new formations in gelatinous substances, a three dimensional bowl shape is very easy to obtain.

As remarked above, we do not here mean to include among rhythmic crystallizations those crystalline precipitations in which the deposits are conditioned by an exchange in external relations. The term should rather be confined to those cases in which an "inner rhythm" is manifestly operative. However, it is very often impossible to make a distinction in this report in those forms which occur in nature. This holds good, for instance, in many stratified crystals, as in cap quartz. (In contrast to the objects hitherto described these do not separate out from a previously existing solid foreign medium. The reservations voiced above concerning the possibility of a transition into the three-dimensional, need not here be considered.)

Thus the cap quartzes have heretofore been explained by the supposition that more sericite or the solution of similar substances entered from time to time into the mother liquor which is rich in silicic acid. This indicates, consequently, an external rhythm. But an internal rhythm can also be conceived of, i. e. a stratified precipitation, although during the process of crystallization nothing enters the mother liquor in deposits, and furthermore neither temperature nor pressure is abruptly [this word—either abture nor pressure, is abruptly altered. This might be possible in the following manner:

The mother liquor might have contained a large amount of silicic acid and some dissolved sericite. During the slow process of cooling a part of the silicic acid may have been first deposited in the form of quartz crystals. In the meantime the sericite also must have formed first a saturated and then a super-saturated solution. Finally there would occur the deposit of the super-saturated dissolved portion upon the quartz crystals. In the meantime the growth of the latter would progress. Fresh silicic acid would be deposited upon the layer of sericite. In this manner a further nucleus effect of the latter upon the mother liquor would be checked. The solution may become super-saturated with sericite until a spontaneous deposit must again occur as a result of too high a degree of concentration. This mode of procedure continues until cap quartz is formed as a result of it. As an actual matter of fact we are here concerned with a rhythmical deposit of sericite. An intermittent interruption of the silicic acid cystallization is not inevitable, therefore. The silicic acid is peculiarly fitted for such formations, because it is capable of forming almost no mixed crystals.

It is possible to extend the same theory of "nucleus isolation" to other stratified crystals also. It may support the doctrine of phases, in cases in which this hypothesis alone is capable of explaining the single, but not the manifold exchange in the deposit of two substances.

[1] E. Küster, Weber rhythmische Krystallisation. Beiträge zur Kenntnis der Liesegangschen Ringe und verwandter Phänomene. (Rhythmic Crystallization. Contributions to the Study of the Liesegang Rings and related Phenomena.) III, Kolloid Zts. 1914, Bd. 14, S. 307.

[2] R. E. Liesegang. Trocknungserscheinungen in Gelen. (Phenomena of the Drying of Gelationous Substances). Gedenkboek Van Bemmelen, S. 33 (1910).

[3] R. E. Liesegang. Deformation von Gallerten durch Gefrierung. (Deformation through Freezing of Gelatinous Substances. Kolloid Zts. Bd. 10 (1912) S. 225.

[4] R. E. Liesegang. Sphärokristalle von Eis (Sperical Crystals of Ice). Zts. für Kristallographie, Bd. 50 (1911). S. 40.

[5] E. Küster, Weber rhythmische Erscheinungen in Pflanzenreich. (Rhythmical Phenomena among Plants). *Die Naturwissenschaften*, Bd. 2 (1914) Heft 4.

[6] R. E. Liesegang. Weber schalig-disperse Systeme. (Concerning Bowl Shaped Dispersion Systems.) Kolloid Zts. Bd. 12 (1913), S. 209.

New Glow-lamp

This new glow-lamp is made by a Berlin firm and is intended to be used for signalling purposes. It takes between 1 and 5 watts at 220 volts, a wattage which is impossible with the finest tungsten wire yet made. The slight dielectric cohesion of neon gas causes bright discharges to take place between closely adjacent electrodes at 150 volts. Arc discharges, carrying heavier currents, can be passed through tubes of some length, containing rarefied neon, at 100 volts: but for a consumption of 5 watts, it is necessary to limit oneself to glow discharges. The present lamp was developed by the author in conjunction with O. Schaller. It depends on the "positive light column," which arises in an atmosphere consisting of a mixture of helium and neon at a pressure between 8 and 10 mm. The kathode has a flat surface, and is placed so near the anode that the discharge begins at 220 volts, the current being limited by a serious resistance. The glow is caused by the collision of the negative and positive ions in the neighborhood of the surface of the kathode. The illumination is slight, but is greatest if some of the common metals are used for the anode. Some figures are given showing the results with Fe. Al. and K as kathode. Iron is at present used, though its efficiency is lower than that of Al and K; at present it is the only available metal and is more easy to work in the form of a very thin sheet. Moreover, it gives off less gas in a vacuum, and volatilises less. The life of the lamp depends on the rate at which the kathode volatilizes. The lamp is contained in a bulb, 55 mm. in diam., and contains a hemispherical kathode of polished iron. The discharge in neon is somewhat of an orange-red colour; this is corrected by the addition of some mercury vapour. The resulting colour is a whitish-rose; the illumination is greater than with pure neon. The anode is an iron hook at a distance of 3 mm from the edge of the kathode. The lamp is not intended for general illuminating purposes, but is said to be used for signaling and other similar purposes for which a glow is found to be sufficient.—(*Science Extracts* from *Elekt. Zeits.*)

Battery-Propelled Fishing Vessels

The Norwegian fishing fleet includes no less than 10,000 motor-boats, and the lack of gasoline has caused the Norwegian Fishery Administration to examine the question of substituting electricity, which is cheaply obtainable in the country, to propel the vessels.

The inquiry made up to date has shown that the accumulators obtainable commercially are too heavy and costly for the purpose, and are too restricted in capacity to give the range as soluble, and the Cabinet will present to Parliament a demand for a credit of 20,000 crowns, to enable the professors of the Trondhjem Technical School to carry out researches on the problem of the electrical propulsion of fishing boats.—(Abstracted by the *Technical Review* from *Revue générale de l'Electricité.*)

The Dome of the Rock*

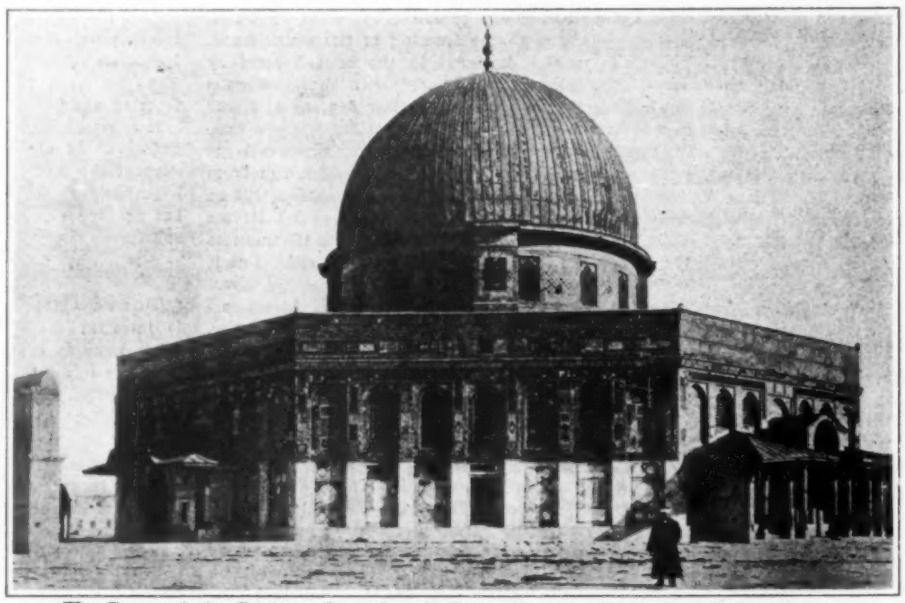
The Famous Structure Built Over the Rock on Which, According to Tradition, Abraham Intended to Sacrifice His Son Isaac

NEARLY two years have now passed since, on December 9, 1917, the Allied Armies, under the command of General Sir Edmund Allenby, drove the Turks from Jerusalem and brought to the population of Christians, Muslems and Jews new hopes of liberty and prosperity as well as the more immediately appreciated boon of food, of which supplies were low.

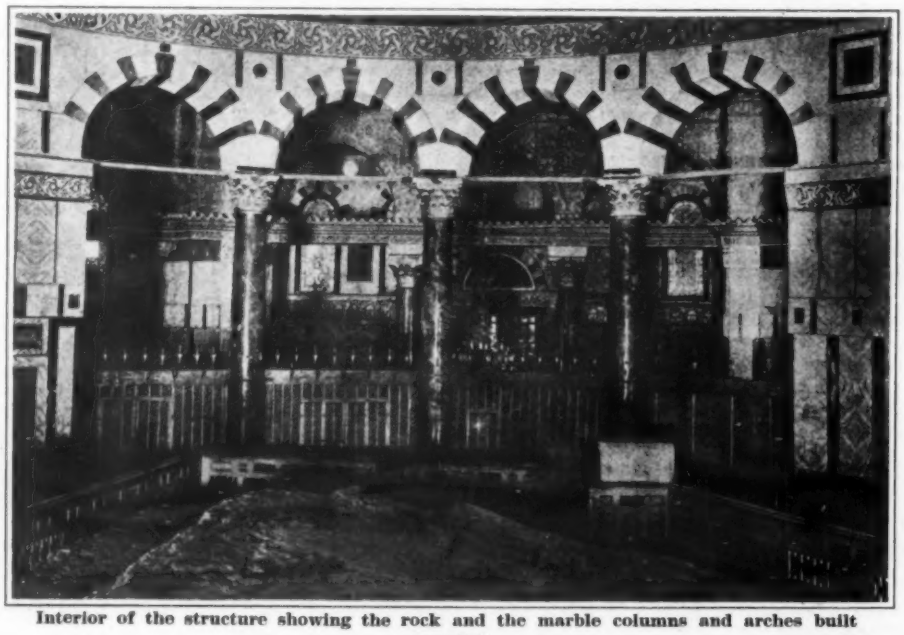
The traditionary guardians of the sanctuary of Mount Zion had for long desired to stop the progressive decay of the buildings within its precincts, particularly of the Dome of the Rock. The war and other circumstances had prevented anything from being done. In the spring following General Allenby's occupation their hopes revived; they consulted General Ronald Storrs, the Military Governor of Jerusalem, and as a consequence a survey was undertaken with a view of providing a considered plan of work to be carried out as soon as conditions might allow. Every facility for a detailed examnation of the building was given by the Muslim authorities, and great interest in the results and progress of the survey was taken by the Commander-in-Chief, who paid several visits to the Dome of the Rock during the progress of the survey.

In order to gain a closer appreciation of the structure and the problem of its preservation, General Allenby even walked round the narrow and slippery cornice that divides the drum from the dome, and entered through a narrow opening, the gallery at the springing of the dome. From this gallery the Sacred Rock can be seen very well about sixty feet below, spread out much as it is shown in one of the photographs on the opposite page. From here, also, the double dome can be examined, with its ribs of cedar and oak and pine that rise into the darkness above.

The accompanying photographs, furnished by the American Colony, Jerusalem, give some idea of the beauty of this structure. It occupies one of the most profoundly interesting sites in the whole world, that of the Jewish Temple on Mount Zion. Although considerable controversy has ranged around its origin, there can be little doubt, as an inscription in the interior indeed testifies ,that it was built by an Arabic "Prince of the Faithful," within the first century following the Hejira. Tradition has it that this is the rock on which Abraham intended to sacrifice his son Isaac, in obedience to the command of God, and it is held that on the assumption that this spot was the center of the world, the Ark of the Covenant is said to have rested here. However, authorities are not agreed on these points. The beautiful marble columns and arches of the structure built around the rock are shown in one of the photographs, also the rich mosaic decorations. Two examples of tile decoration are shown in the headpiece.



The Dome of the Rock in Jerusalem built on the site of the Jewish Temple.



Interior of the structure showing the rock and the marble columns and arches built around it.

Byzantine in style and octagonal in shape with a dome rising to a height of about a hundred feet the ancient fane contrasts strikingly with the severity of its surroundings.

Although the structural condition of the building is fairly good, its surface decoration, particularly that of the tiles outside, must cause anxiety.

Prior to the tile decoration the building was covered with mosaics externally. Tiles took the place of mosaics, probably because the mosaics had fallen into disrepair and tilemakers could be found more easily than mosaic-workers. Today it is the tile decoration that threatens to disappear. Moreover, there is nothing to take its place. Who first covered the building with tiles is unknown, but a considerable proportion of those now in place date from the middle of the sixteenth century, when a great work of repair was carried out by Suleiman the Magnificent, son of a former conqueror of Palestine. A record of his work is preserved in an inscription over the northern door, from which we learn that the structure and decoration of the Dome of the Rock were renewed under the "protecting shadow of the reign" of this ruler.

The British deliverer of Palestine and Syria is no less than Suleiman, "verily and clearly proved to be the Father of Conquest," and instead of an inscription, the presence of a guard of Muslem soldiers from India testifies to the reality of a new protecting shadow. Let us hope that under this protection further decay may be arrested, and that those responsible for this wonderful shrine may be able at least to render visible what remains of that splendor by removing the accumulated dirt of years from the brilliant windows and mosaics of the ancient structure.

* From the *Graphic* (London)

Animal Spies.*

By K. Ishikawa.

THE use of animals as spies has been a military art practiced in Japan from remote times. The animals so used were the dog, fox, and rat, which were duly trained for the purpose. The animals mentioned were selected because for such a purpose as spying they are the most amenable to training, and have proved the most successful in operation. They can be trained to understand human will and language to a marvelous degree. The fox can be trained even to imitate the human voice, and the power of the animal in this direction is very effective, especially when trained to utter low sounds. It is only common knowledge that dogs and cats can be trained to understand human speech. A well-trained dog can easily grasp one's meaning when ordered to go away or to approach; and so can a cat. If you order a dog to approach you when he knows very well you intend to punish him he again reveals to a wonderful degree an accurate knowledge of your mind. Dog-killers are never successful in having dogs obey them, and dogs will not be persuaded to come near them, even for food. In order to win the confidence of animals and then train them, one has to be kind and gentle towards them. Animals are most susceptible to affection and readily averse to the opposite, even beasts of prey. The writer has had an extensive experience in the training of birds and horses, and knows whereof he speaks.

The fox must be reckoned among the most clever of the wild animals. In Japan there are no less than six kinds of foxes. The *osaki* is the fox with the divided tail, as the name implies. Then there is the *izuna*, so called because it is believed by some to be used as a messenger by a god of the same name in the province of Shinano. Another fox is known as the *kuda*. The three species aforementioned are all small foxes. The white fox and the black variety have disappeared from Japan, though they still exist in China. Recently the government has been importing black foxes for breeding purposes from Prince Edward Island in Canada. It is said that there are still a

* From the *Japan Magazine*

few of these foxes wild in Hokkaido, but the number is so small that they are never seen.

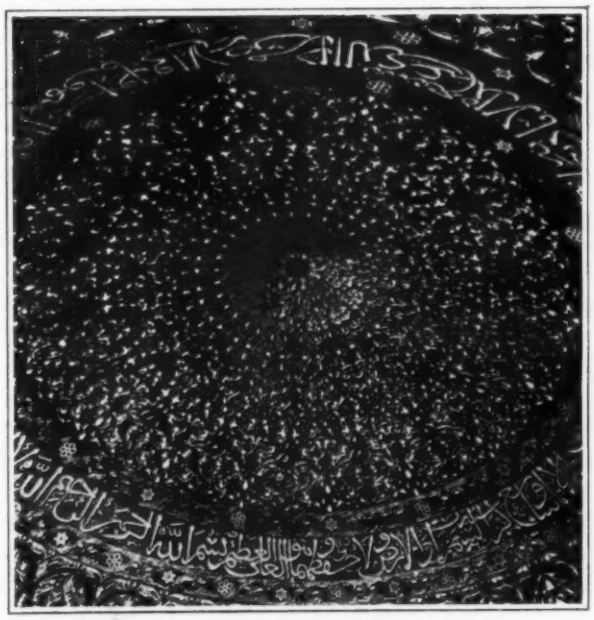
In Japanese mythology the fox is represented as having been born first into this world at the descent of the Sun Goddess, and even now when a fox is seen he is regarded by most of the more humble classes as a messenger of heaven, especially of the god Imari. The rat is considered to be the messenger of the god Okuninushinomikoto, while the dog represents the god Yamatotakeru-no-mikoto; and the pigeon carries messages for Hachiman, the god of war. These were all used as spies by the Japanese military authorities in feudal times.

When a military officer desired to ascertain certain geographical facts as to the situation of a camp or fortress held by the enemy, he found the dog or fox his most efficient spy. In feudal times certain places were always guarded, and all travellers passing either way through these barriers were strictly examined, while other likely places had watchmen hidden; but the entire country could not be so covered. For this purpose the ubiquitous fox was utilized. Human spies guarded the pathways over the mountains and across the plains; but the fox guarded the wilds and other pathless regions. The fox is small and not easily seen; he knows every foot of the country he traverses. Always on the trail the animal spy follows the human spy. When the fox or the spy dog perceives or detects the presences of a human being in the course of his patrol he utters a faint sound, which his master behind understands and notes. The animal utters various sounds, and these are signals for the master to follow up or retire, as the case may require. The animal is trained to vary the cry whether the enemy is approaching or retreating. When the master finds he has lost the trail and cannot find his way out of the forest or mountain, he imitates the cry of the fox, and gets a reply that guides him the way he desires to go. If he continues to cry or bark in a special way the fox will come to him and lead him aright. Even today hunters adopt the same methods.

Some of these foxes have been trained to perform deeds almost incredible on behalf of their masters. For example, when the spy comes to a precipice or cliff he finds it impossible to ascend. he puts the end of a rope in the fox's mouth; the animal finds its way up the cliff as no human being could do, and when it reaches the top it walks round and round a tree holding the rope in its mouth, while the man at the other end pulls himself up the cliff. The fox will hold on till the master arrives. In the same way the animal is used to discover a way down cliffs or precipices. He can also fasten his rope to a tree, using a bow knot; and after he descends the fox will pull open the knot and the man recovers his rope. If the spy is obliged to pass the night on a mountain or some remote place where the air is very cold, the fox will lie up against him all night and keep him warm. The animal has a keener sense of smell and a better instinct for situations than his master, and is thus able to keep the latter informed about every step of the way.

There are frequent references to the use of animals in this capacity in Japanese literature. For example, in the famous novel, "Yumiharizuki," Tametomo is represented as being rescued by his dog Nokazé from a venomous serpent one day while he was out hunting. The fox can even make light for his master when the darkness is too extreme. All the master has to do is to give him a certain kind of bone to carry, and as he breathes on it there is an emission of phosphorescence that the man can easily see and follow the animal. The bone can be picked up often in the mountains where skeletons of dead animals are found. If an enemy sees this light he is more apt to be afraid of it than to approach it, as he thinks it a will-of-the-wisp. Even spies placed in charge of barriers used to keep a dog or a fox always near them, as this precaution allowed them to doze or even sleep on duty; and also when a spy was surveying an enemy's position the fox enabled his master to know whether the sentinels were asleep or awake, and what the situation was.

Rats, too, were used as spies by the army officers of feudal Japan. The spy carried his pet rat in his sleeve. On approaching the position to be spied upon he took the animal from his sleeve and let it go free. The rat was trained to pick up any bit of paper it could find and bring it to its master. Accordingly it would penetrate into the apartments of the officers of the enemy camp in a noiseless manner and steal off with any pieces of paper it saw, which, perchance, might contain the enemy's plan of campaign or tactics for the ensuing battle. Sometimes the rat was trained to make a noise in the enemy camp and awake the sentinels, so that, after finding they had been disturbed only by a rat, they would become more indifferent than ever, and go soundly to sleep, not to be awakened by the human spy close on the trail of the rat. In this way many a spy has been enabled to steal into a samurai camp and get away with valuable information.



The beautiful dome as seen from the rock.

The sacred rock as viewed from the dome.

THE DOME OF THE ROCK. (See opposite page.)

Another dodge was to hide oneself under the floor of the enemy's house or camp, and let out the rat to find out whether the occupants of the house were asleep or awake, or if asleep whether they were sleeping soundly or not. For this reason, the floors of daimyo houses were made double, and in the case of greater daimyo, including the shogun, three-fold. Now it is supposed to be done to keep out dampness, but the original reason was to prevent the entrance of spying rats.

The mansions of all the old feudal lords and all the persons of distinction in ancient times were built with one long corridor running along one side, sometimes called the *uguisu-bari*, because if anyone walks along it the creaking boards emit a sound like the song of the *uguisu*, or bush-warbler. This passageway is usually made of *hinoki*, or cypress wood. The edges of the boards are so fitted that they give forth the peculiar sound mentioned, no matter who walks on them. In the old Chionin palace at Kyoto one has a good example of the *uguisu-bari*. Now, this was done simply for the purpose of revealing the attempt of spies to enter the house at night. In one of the older plays of Japan, Ninki Danjo becomes a rat and creeps into a certain room; but he is caught in the act by Onosuké and knocked on the head. This is no other than an imitation of the spy system of feudal times.

The method of using animals as military spies reached the height of perfection in Japan during the period of the civil wars. After the warring diamyo were put down and peace was permanently established the spy lost his job and his talent and efficiency declined. Most of the spies came up to Yedo, the Shogun's capital, as a likely place to find their services continued. The Shogun naturally had considerable use for spies, and sent them to various corners of the Empire to inform him of what was going on. During the period when the possession of Osaka Castle was uncertain the Tokugawa shogun kept many spies in that region; but after the fall of the fortress these returned to Yedo. To the more important of these trusted ones the Shogun gave extensive lands and estates, and pensions to others. They were regarded as the *kitsune-tsukai*, or men who spy by a fox, and in later years, their fortunes having declined, they made a living by fortune-telling, palmistry, and such occult arts. This sort of thing greatly prevailed in Yedo up to the Restoration in 1868, and there is a good deal of it even still, though the fox-workers now find credit for the most part only among the more ignorant folk.—*Japan Magazine.*

Time Relations in a Dream

The following account of a dream which I had last night, and of which I took some notes, may be of interest. The dream commenced by my, as I thought, hearing a drop fall on the laboratory floor; after a time there was another drop. I then realized that mercury was dropping on the floor from a small split in some rubber tubing in a gas-analysis apparatus. As I became more wakeful and seemed to realize that I must get up to deal with the leak, the drops fell more rapidly until they were coming quite fast at the moment when I definitely awoke. I then realised that the dropping of mercury which I heard in my dream was in reality the ticking of the clock in my room.

The point which interested me, and may, I think, interest you, is that of the time relations of the dream. I went over my memory afterwards with a stop watch, with the following results:—

As I dreamed it, the interval between the first two drops seemed to be of the order of five seconds, and the drops seemed to quicken until they were at an estimated rate of about one drop per second.

Now the actual rate of ticking of the clock was one tick every quarter of a second. It is, of course, evident that one's judgment of time in a dream is quite erroneous in the sense that the occurrences as they take place in the dream seem to extend over a much longer time than the actual time of the dream.

On the assumption that each consecutive drop in my dream corresponded with one consecutive tick, it would appear that at the commencement of the dream the time interval between two consecutive ticks was exaggerated about twenty-fold in the dream, and that as I got more nearly awake the degree of exaggeration became reduced to something like four-fold. At a guess, I heard about thirty drops, in which case the dream would have lasted seven to eight seconds.

There is another possible interpretation, namely, that when I was most soundly asleep only one tick out of twenty came through to my consciousness, and that as I became more wakeful the number increased until one tick in four came through. On the latter theory the dream would have lasted considerably longer than on the former.—Joseph Barcroft in *Nature* (London).

The Navigational Compass*

Difficulties Encountered in the Effort to Make It an Instrument of Precision

By M. B. Field, O. B. E.

THE design and use of the navigational compass involves a variety of problems relating to mechanics and mechanical construction, wear and tear of materials, the effect of very complex vibrations, fluid friction, viscosity and fluid motions, terrestrial magnetism and the magnetic properties of iron and steel, and complicated systems of magnetic potential and fields of force. It will only be possible to deal with a few of these many problems.

Ordinarily a magnetic needle should indicate the direction of the magnetic force in the region in which it is placed, and therefore, except for the necessary local disturbance which the needle may itself produce, the direction of the meridian. Its precision depends on accuracy of workmanship and freedom from pivot friction. The error may be reduced to the same order as the error of unaided observation. Much more, however, is required from a navigational compass. The ship itself is magnetic, and may, therefore, as it swings produce cyclic changes in the apparent direction of the meridian and the magnitude of the magnetic field. This deviation of the magnetic force in the plane of the meridian is also affected by the ship's absolute geographical position, by the ship's shape and

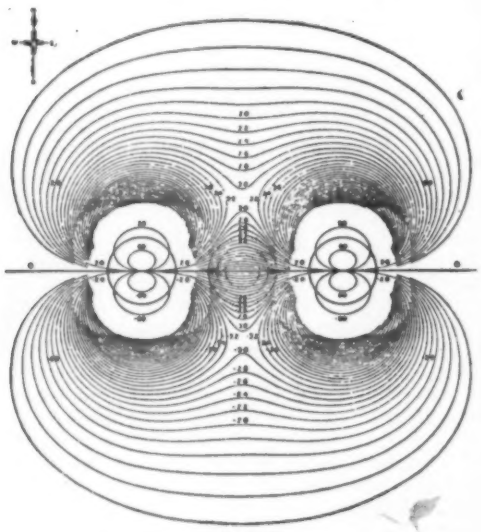


Fig. 1.

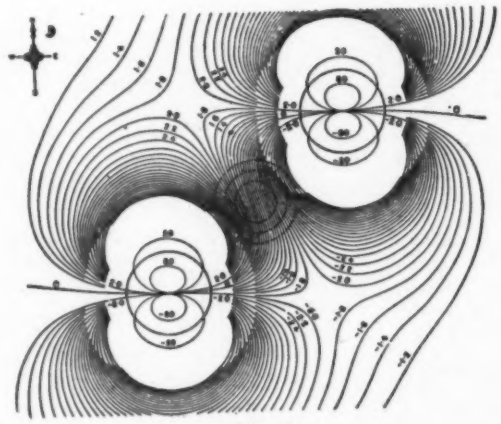


Fig. 2.

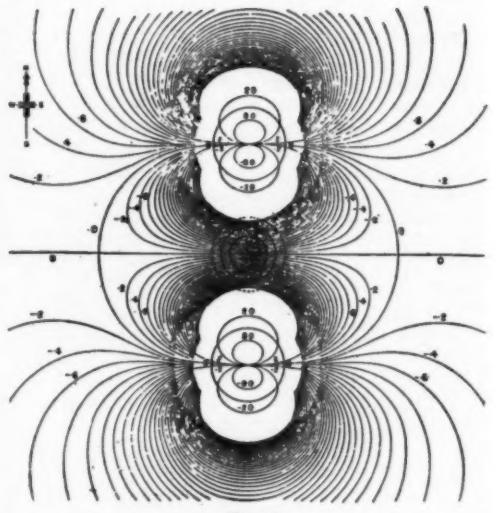


Fig. 3.

The magnetic field about a ship compass equipped with binnacle spheres, showing the equipotential lines for the case (fig. 1) where the line joining the centers of the spheres runs east and wst; whn the vessel is steering a quadrantal course (fig. 2); and when the ship is on an easterly or westerly course (fig. 3). (In each figure the dotted circles represent the position of the compass card)

proportions, and even the locality in which she was built; the past history is thus an important factor.

The compass must ignore all misleading suggestions due to such causes. We may annul by magnets and otherwise the magnetism of the ship so as to obtain complete compensation on all courses, with all positions of the ship and at all parts of the earth. Or, again, if we neutralize the east-westerly component of the ship's magnetism, and the neutralization is effective under the above conditions, the compass is completely compensated. In practice we annul some components of the ship's magnetism and neutralize the east-westerly force of others, so that the compensation is nearly complete under the above conditions, provided the so-called permanent magnetism of the ship remains permanent, and the so-called induced magnetism is strictly proportional to the inducing force, vanishing when this force is withdrawn. Unfortunately, the permanent magnetism is not permanently "permanent," and the induced magnetism not instantly "transient," and our complete compensation is therefore incomplete.

Much permanent magnetism is said to be "hammered into a ship during building" and "shaken out" during her first few voyages, or, on a new warship during gun-firing trials. Semi-permanent magnetism may be picked up by a ship on a certain course, and lost more or less gradually. Precision is thus also dependent on what Lord Kelvin has termed "unpredictable irregularities," from which no form of instrument is entirely immune. Lord Kelvin, in his various lectures and addresses, has given a striking account of the circumstances that led him to devise a mariner's compass which would be a proper instrument of precision, and of the many modifications introduced over a period of five years. In 1839 Sir George Airey, Astronomer Royal, described further investigations undertaken at the request of the Admiralty, and suggested method of correcting for the ship's magnetism, which were quickly adapted to iron-built ships in the merchant service. In some cases difficulties were, however, experienced, errors of two kinds being introduced arising from the lengths of the needle and its magnetic moment.

In selecting the position for a compass station on board ship care is taken that the nearest iron should be at a relatively great distance, so that the field in the vicinity of the compass may be sensibly uniform, and there may be no sensible attraction due to magnetism induced in the needle by the iron. If these conditions are observed, the position of equilibrium of the uncompensated card does not depend upon whether the needle is long or short. In Airey's method, compensation was effected by placing magnets and masses of iron near the compass in calculated position, so as exactly to counterbalance deviations due to the ship's iron work. These masses, of considerable size, are incorporated as part of the compass binnacle. Now the magnetic fields to which these give rise are not uniform over the region swept out by a long needle card, so that the positions of equilibrium for a short and long needle are not the same.

For example, it is usual to employ two cast-iron spheres attached to the binnacle for the correction of one of the effects of ship's magnetism—viz., the quadrantal effect. These spheres may be 8 in. diameter, placed on either side of the compass at about 12 in. from the card center and level with the card. They become magnetized by the earth's field, and behave, so far as external points are concerned, as extremely short magnets of definite magnetic moment, always pointing along the line of resultant magnetic force. Now, we may draw the lines of magnetic force and lines of equal potential values due to such a system. Equipotential lines are exhibited in Fig. 1 for the case where the line joining the centers of the spheres is E—W (magnetic); it will be seen that this field is by no means uniform. A uniform field would be represented by a family of straight parallel and equidistant equipotential lines. We thus employ a non-uniform field, such as that shown in Fig. 1, to correct the compass for the deviation produced by a perfectly uniform field arising from some effect of ship's magnetism. Fig. 2 shows the equipotential lines due to the magnetization of the globes when the ship is steering a quadrantal course. Fig. 3 represents the effect when the ship is on easterly or westerly course. In all cases —1, 2 and 3—the interesting part of the field is where the dotted circles are drawn. This is the position of the compass card. The smallest dotted circle represents the area swept out by needles 4 in. long; the intermediate circle corresponds to 6-in. needles, the largest circle to 8-in. needles. The un-uniformity in this region is sufficient to account for appreciable secondary errors when using needles of considerable length.

We have then to remember that correctors, while introducing magnetic forces which neutralize those due to the ship, introduce additional forces which may produce deviations depending on:—

(*a*) The length and arrangement of the magnetic needles.

(*b*) The magnetic moment of the needles.

In view of the difficulties experienced in the adjustment of the standard compass of the "Great Eastern," the errors which arise from the length and arrangement of the needles were carefully studied experimentally by Commander Evans, and mathematically by Archibald Smith, the results of the investigation being given in the combined Paper in the "Philosophical Transactions," 1861.

By this investigation the authors arrived at a remarkable result—namely, that by a certain arrangement of needles on a compass card, in place of a single needle, the errors due to length of needle very nearly disappeared, and that the particular arrangement necessary for the fulfilment of this condition was the very one which had been adopted in the construction of the standard Admiralty compass, entirely on account of other considerations. The standard Admiralty compass card at that date was provided with four needles arranged as in Fig. 4. The object of this particular arrangement was to ensure that the moment of inertia of the system about all diameters was the same, a condition favorable to the elimination of what was termed "wobbly" motion of the card.

The coincidence discovered mathematically and demonstrated experimentally by Smith and Evans was that if the poles of the needles in the two-needle card subtend 60 deg., or in the four-needle card are placed at equal distances measured circumferentially from the extremities of the 60 deg. chords, as, for example, in Fig. 4 the magnetic errors due to length of needle largely disappear.

For the purpose of producing steadiness, one naturally inclines to some method of fluid friction damping, but for definite practical considerations, to be later discussed, Lord Kelvin dismissed the idea of fluid damping. He rather sought to render the card inherently stable under ordinary sea-going conditions.

The other intensely practical considerations from the mariner's point of view were, as usual, prominently before Lord Kelvin. The card must stand rough handling, it should be capable of deformation and yielding to stresses and of recovery without damage. It must stand the weather of all climates, intense heat and cold, prolonged dryness and humidity without warping; while the pivot, jewel, or even the card itself, must be capable of replacement at a moment's notice, in case of emergency, by spares usually provided with the out-

*Abstract of a lecture before the Institution of Electrical Engineers.

fit, and this must be possible without liability of damage by a not very delicate-handed navigator under favorable conditions at sea.

Lord Kelvin states that the weight of his design was one-seventeenth part of the weight of the ordinary 10-in. card hitherto in common use in the best found merchant steamers, which was about 6 ozs. Further, that the magnetic moment was only about one-thirteenth part of that of the two needles of the ordinary 10-in. card as made at that date, and was so small that the error due to its inductive influence on the iron globes used for correcting the quadrantal error was practically insensible. As an alternative to the "dry" compass just described, we have the liquid or spirit-filled compass. The liquid type is undoubtedly favored by some navigators on account of its extreme deadbeatness, especially for steering purposes. In small light craft it becomes a necessity in rough weather, and whenever space restrictions do not permit of the use of a 10-in. dry card the spirit compass should be resorted to.

This type, however, is by no means perfect, and suffers from the disadvantages that it is very much overdamped, necessitating an undesirably great magnetic moment, and, consequently, a great mass in the moving system.

Some idea of the strength of the needles and the great masses employed in the cards of liquid compasses may be formed by a perusal of the table, comparing a 10-in. Kelvin card (dry) with various makes of card for liquid compasses. In every case the liquid employed is 50 per cent. alcohol and 50 per cent. water at 20 deg. C. In the case of the liquid compass the card is deviated 45 deg. and released; the time interval between the first and second transit of N-point of card past the lubber line is the half period.

In order to reduce the requisite magnetic moment, one naturally considers how to reduce the moment of inertia of the card; but when the moment of inertia has been reduced to the furthest limit the magnetic moment must still be considerable, if we are to have a moderately quick-acting card. The reason is that the effective moment of inertia does not reside solely in the card, but partly in the fluid.

As the card oscillates the liquid in the immediate vicinity of the card is dragged backwards and forwards with it, and this has the effect of apparently augmenting the moment of inertia of the card itself.

Thus, when we have reduced the moment of inertia of the solid moving system to the furthest possible limit, we may find the effect of the liquid dragged by it is equivalent to a moment of inertia several times as great as that of the card itself.

We have, in fact, a total effect of:—

First, loading the card with an additional moment of inertia;

Secondly, retarding it by a damping torque at every instant proportional to the velocity.

Both of these effects are proportional to a quantity $V\mu\rho$, where μ is the coefficient of viscosity and ρ is the density of the liquid. If we can materially reduce this quantity, we shall materially improve the behavior of the compass. In my opinion, a real improvement is to be looked for in the spirit compass by finding a more suitable substitute for the liquid now commonly employed.

Archibald Smith showed that to obviate the length of needle error, the "poles" of the needle in the two-needle card should subtend an angle of 60 deg. at the card center. This was given by him in his 1861 Paper in the "Trans." Roy. Soc., London. In elaborating this theory, Smith assumed that the magnetism might be considered as concentrated at points near the ends of the needles; hence the expression "poles".

While this is legitimate when we are considering the couple exerted in the needle in a uniform field, it is not strictly legitimate when we are dealing with non-uniform fields.

In the original paper the author then proceeds to discuss this problem in detail. This involves the conception and use of a uniform field of unit intensity vertically downwards between two transverse planes. The difficulty of using infinite current sheets is got over by various devices, which he describes and illustrates. This leads to a convenient apparatus for measuring the magnetic moments of cards without removing them from the containing bowls. This is illustrated in Fig. 5. It consists of a glass jar, inside which a needle, arranged to be astatic in the earth's field, is suspended from a torsion head.

	Diameter of card. In.	Max. length of needle. In.	Weight in air. Grammes.	Moment of inertia. C.G.S.	Magnetic moment. C.G.S.	Time of half period at Glasgow Seconds.
Standard 10 in. "dry" card	10	3½	13	1,200	300	16 (in air)
Naval liquid compass	6½	3¾	82	1,000	1,600	16
U. S. A. Naval ditto (Ritchie)	7½	4½	100	2,910	2,400	21
Ritchie	9	7¼	152	3,270	5,160	20.5
Common steering compass	9	7	135	5,110	2,300	30

Table I.—The performance of a dry standard 10- nch compass. Cards compared with that of some familiar liquid cards

Each element of the needle has a strength of about 600 c.g.s. units, the elements being separated by about 10 c.m.s. The lower one swings clear of the bottom of the jar, and is immersed in damping fluid. The spindle is supported on a fibre and controlled by a torsion spring, the ends of which are attached to the spindle and the torsion head respectively. The spindle carries a pointer which moves over a graduated dial attached to and moving with the torsion head; but arranged to be independently rotatable, so that it can be set to zero when the tension of the control spring is zero.

The jar is placed centrally on the compass bowl glass, and in this position the lower element of the astatic

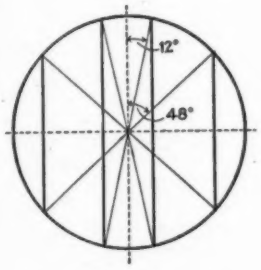


Fig. 4

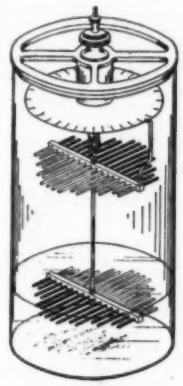


Fig. 5

The arrangement of needles that gives most uniform results, and the apparatus for measuring the magnetic movement of compass cards.

combination comes within range of sensible force of the card needles.

The torsion head is rotated until the card is deflected into E-W position. We then know that the earth is acting upon the card with a torque equal to HM, and since the astatic needle is co-axial with the cord the torques mutually exerted between card and astatic system are also HM. This, however, is the only magnetic couple acting upon the astatic system, and it must, therefore, be balanced by the torsion of the control spring.

Since one end of the spring is virtually attached to the dial and the other to the pointer, the position of the pointer on the dial represents the amount of torsion of the spring.

The torsion head may, therefore, be calibrated to read M direct for any place where H is known, it being understood that M is indicated on the dial when the torsion is such that the card under test is deflected into the E-W Meridian..

Where a very powerful card is under test it may be deflected by only 30 deg., in which case the readings of the torsion head must be doubled.

It will be observed the accuracy of the device depends upon:—

1.. The astaticism of the system, which is readily tested and adjusted from time to time; and

2. The calibration of the control springs. It in no way depends upon the strength of the needles of the astatic system, or upon their distance from the card.

For the purpose of measuring moments of small magnets, the apparatus is completed by the addition of a special dry bowl and card (without magnets) provided with a cradle, upon which any small magnet may be placed.

Having measured the magnetic moment, the moment of inertia is most easily determined by calculation from the period of vibration.

The next point dealt with in the paper is the effect of dissymmetry of a card, such as occurs if one of the needles on a two-needle card is materially weaker than the other. Such a card would point "true" in a uniform magnetic field, but not otherwise. An apparatus was exhibited, enabling needles to be rapidly tested for (*a*) equality of magnetic moment, (*b*) symmetry of magnetization about the central plane of each needle.

Another point of consequence is the undesirability of using very great magnetic moments, as strong needles of this description themselves induce magnetism in the compensating iron masses in the vicinity, and this in turn reacts on the needles; the positions assumed by needles of very different magnetic moment may thus not be the same. Formulæ have been prepared permitting the effect to be calculated.

Graphite Deposits in Siberia

Extensive deposits of graphite exist in northwestern Siberia on the left bank of the River Kureika near its junction with the River Yenisei, 90 miles from the mouth of the latter river. The graphite area forms a horizontal plateau, the elevation of which varies from 20 to 50 feet above the normal level of the River Kureika. The plateau contains two layers of graphite, which is of a solid steel-gray color, soft, and of an excellent quality for the manufacture of pencils.

The graphite mines of Siberia were discovered in 1859 by the celebrated explorer Sidoroff, who sent samples of the metal to Russian and foreign laboratories for analyses. These analyses gave the following chemical composition: 85.51 per cent carbon, 0.60 per cent hydrogen, and 9.89 per cent residue. These analyses were confirmed in 1907. The carbon constituent is said to be superior in quality to that found in graphites in other parts of the world. The graphite is not inflammable and is very plastic.

At present it is practicable to ship the graphite only during the summer months by sea from the Yenisei River through the Arctic Ocean. It is believed that in the future the graphites from these mines will supply Russian demands, and that large quantities will be available for export.

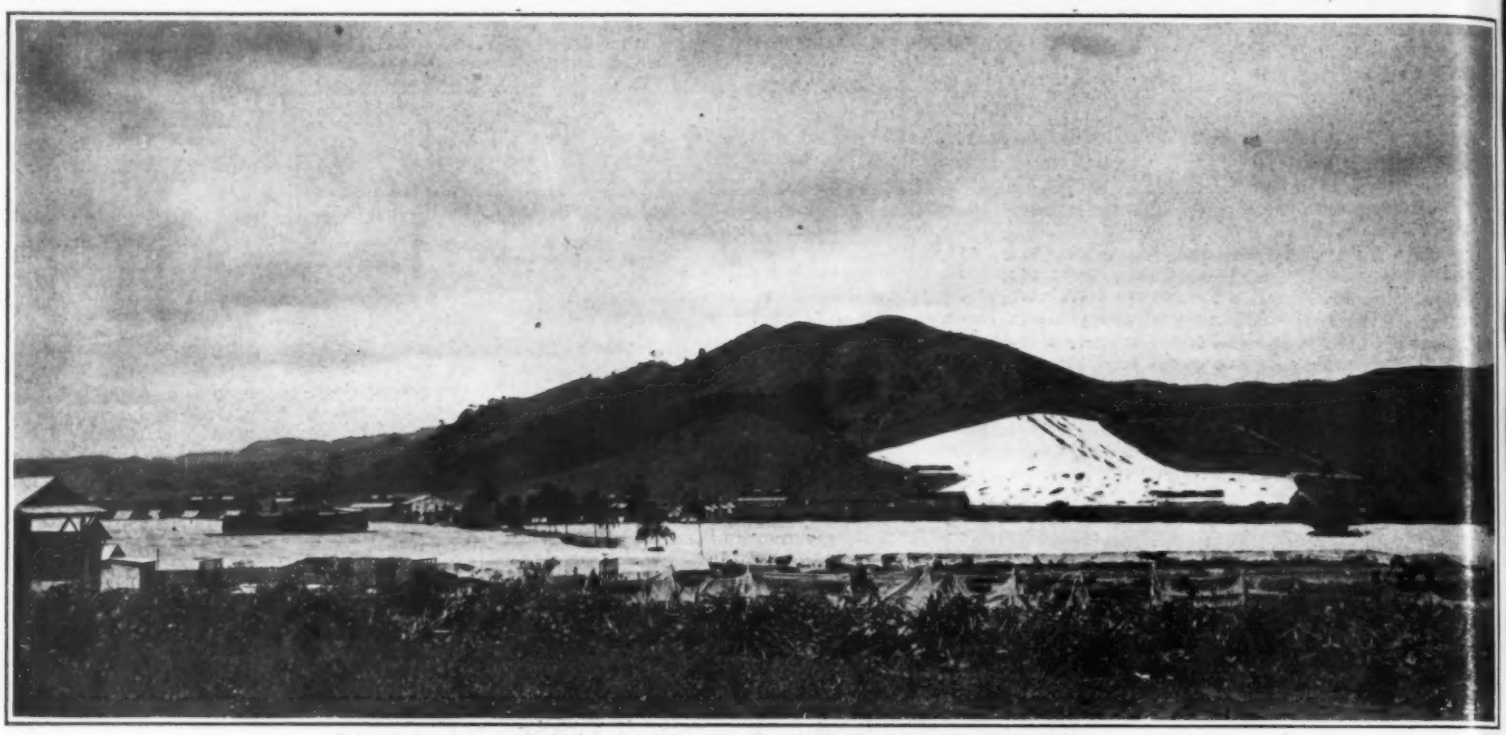
The chief sources of graphite have been Ceylon, Bohemia, Germany, France, and the United States. The annual world production has been approximately 120,000 short tons.—*Commerce Reports.*

Lead Pencil Manufacture.

The making of lead pencils is a more important industry than it may appear to be to the uninformed. Hitherto largely concentrated in Germany, its displacement as one of the consequences of the war, is an occasion for descriptive notices in some of the technical journals.

The crude graphite, from Ceylon and Mexico, is ground to a fine powder and "floated" through a series of settling tanks to grade it and to remove impurities, that which is deposited in the last tank of the series being used for drawing pencils of the best quality. As a binding substance, a certain kind of clay is prepared in a similar manner. The proportion of clay to graphite determines, in part, the grade of hardness of the "leads." With the addition of water to form a paste, a mixture of graphite and clay is passed repeatedly through a grinding mill, then pressed in bags to a consistency of stiff dough. In that state it is passed through dies to form rods, cut into pencil lengths and straightened, after which the rods are dried at a suitable temperature. When sufficiently dried, they are placed in crucible boxes and subjected to a temperature of about 2,000 deg. F., in a muffle furnace. The factors which determine the hardness and blackness of the pencils are the relative proportions of graphite and clay, and the heat to which the mixture is raised. According as the proportion of graphite is greater and the heat lower, the pencil is softer and of a deeper black. Hence the heating process is an important factor in the manufacture.

The wood used is some species of cedar for the best pencils, and pine for the cheaper sorts. The wood is cut into slats a little longer than the finished pencil, and slightly thicker than half the diameter of the pencil. Its width is usually sufficient for six pencils. A planing machine cuts the six grooves for the leads. The leading is done by hand. A cover is glued on to the leaded slat. When the glue has dried the pencils are cut out of the slats by rapidly revolving cutters. This done the pencils are ready for the finishing process which consists in smoothing them down with sand paper, coating them with varnish and trimming them to standard length. The final operation is to stamp them with the trade name and letters or numbers indicating the grade of the pencils. All this work in done by machines.—*American Gas Engineering Company.*



A typical tobacco plantation in Cuba showing fields shaded with cheese-cloth.

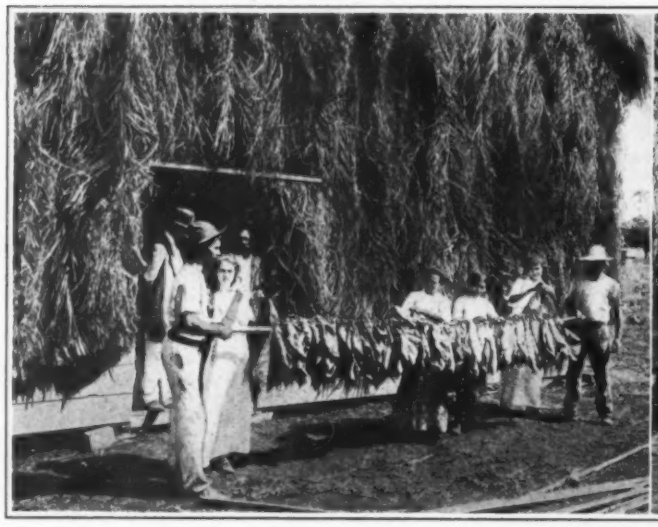
Tobacco-Growing in Cuba

The World's Finest Leaf Grown Under Canopies of Cheese-cloth

By T. C. Francis

ALTHOUGH it stands eighth in the production of tobacco, and that is a remarkable standing for a country scarcely as big as New York State, Cuba leads the world in the quuality of its product.

What it is that gives Cuban tobacco its fine aroma is hard to determine. Tobacco is a most adaptable weed that will adjust itself to almost any climatic conditions in the temperate and tropical zones. It grows as far north as Stockholm, Sweden, and as far south as the Cape of Good Hope. But its adjustment to different habitats is not effected without wide variations in quality. Only in a few places on earth can a really fine grade of leaf be grown. The delicate, fragrant leaf of Cuba cannot be duplicated anywhere outside of the Island Republic. Conditions of soil and climate have been studied most minutely and efforts have been made to reproduce them in other localities, but without success. Quality of soil, exposure to light, range of temperature all have a marked influence upon the texture and flavor and nowhere else do all these elements combine to the same advantage as in Cuba. And this is not true of all of Cuba either. There is one region in the province of Pinar del Rio where the very finest tabacco in the world is produced. This is known as the "Vuelta Abajo." Other tobacco producing regions in order of importance are Havana, Santa Clara and Santiago de Cuba.



Stringing the leaves on a pole which is hung in the drying hut at the rear

Bringing in a load of tobacco leaves

Because of its fine aroma the Cuban product is particularly adapted for cigar fillers. The best wrappers are grown in Sumatra, the leaves being very thin and flexible, but lacking the fine aroma of the Cuban totbacco. an attempt was made some years ago to raise Sumatra tobacco in Florida, but without much success. But in studying the problem it was observed that the leaves of plants tha twere grown under the partial shade of trees, for instance at the edge of a wood, were finer and better texture, and so the scheme was hit upon of furnishing artificial shade by covering the fields with cloth. This proved so successful that Florida-grown wrappers were even exported to Cuba. Cloth shade was introduced into Connecticut and other states and eventually was introduced into Cuba. Hundreds of acres of fine tobacco are now raised under canopies of cheese-cloth and the sight of broad fields of white, like patches of snow, on the green landscape is a most curious spectacle.

The frontispiece gives us a glimpse of the workers under one of these canopies picking the tobacco leaves. All this work is done by hand. In the United States the coarser varieties of tobacco are harvested by machine but in the fine grade tobacco fields of Cuba the leaves are carefully picked as they ripen.

When a plant has reached the stage at which it begins to put forth seed buds or "buttons" it must be "topped," that is the buds must be pinched off and the number of leaves thinned out so that only a few are left to "ripen." When the leaves change from a dark green to a light green and begin to develop yellow spots they are readp to be picked. The

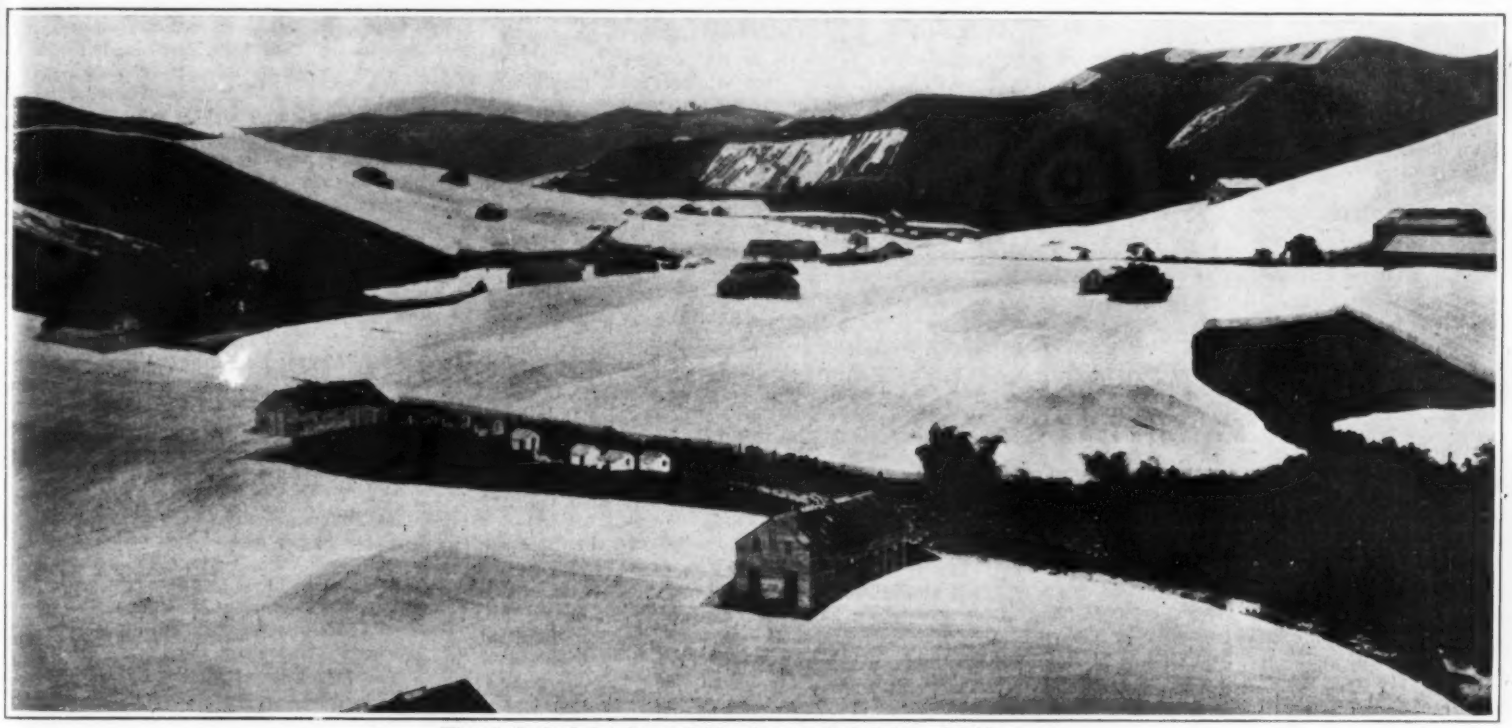
In a cigar factory—Note the reader holding the attention of the men and thus keeping them at work

The roof or cheese-cloth and walls of mosquito netting keep injurious insects out of the field

lower leaves being older than the upper ones, ripen first and in high grade tobacco the pickers have to go through the fields several times picking the leaves as they ripen.

After picking, the leaves are strung on poles and hung up in drying barns to cure. The barns are built with panelled walls, of which alternate panels may be swung open to provide for a free circulation of air. After drying, the leaves are stacked upon the floor of the barn and allowed to ferment. From time to time the pile is opened up and rebuilt until finally all the leaves assume a rich brown color. This treatment of the tobacco has much to do with its fine aroma. After fermentation the leaves are stored in a warehouse for a long period. This aging process makes them more mellow. The tobacco is now ready for export or to be made into cigars at the local factories.

Owing to the Cuban workman's natural aversion to confining labor special inducements are offered to hold the interest of the men and keep them at work. It has become a standard practice to provide "readers" at the cigar factories. Mounted upon an elevated platform, as shown in one of the illustrations, is a man who reads the news of the day and interesting stories for the entertainment of the workers. The reading



The cloth-shaded tobacco fields give tropical Cuba a frigid aspect

holds their attention and keeps them from talking to each other. As our southern neighbors cannot talk without using their hands, and thus interrupting their work, the wisdom of using readers is apparent.

Evolution of Ostrich Plumes

PROF. J. E. DUERDEN has published (Bulletin No. 7, 1918, Department of Agriculture, Union of South Africa, pp. 39, 12 figs.) a fourth report on his breeding experiments with ostriches at the Grootfontein School of Agriculture. His work is full of interest, both theoretically and practically. Birds brought from Nigeria have 33-39 first-row feathers on each wing, with an arithmetical mean of 36.54. If these imported birds represent a pure line, the likelihood is that the numerical variations are fluctuating somatic modifications, and that no amount of selection will increase the average number of plumes beyond that given. If the imported birds represent a mixed population of several pure lines, only appearing pure as a whole because of their small differences, it should be possible to obtain higher averages by always selecting as breeders the birds giving the highest number of plumes.

It turns out that Cape birds have the same number of plumes as the wild Nigerian birds, and it appears, therefore, that during the fifty years of ostrich farming in South Africa no advance whatever has been made on the number of plumes originally present on the wild bird. For farmers have always bred for quality; quantity has never been taken into account. As regards the number of plumes, ostrich-breeding has been carried on altogether indiscriminately, and no advance has been made.

Among the Cape birds in the Grootfontein flock there have been two cases of 42 plumes to the first row. One of these met with a fatal accident; the other bred true. The 42-plumed bird might be regarded as a novel mutation, but there is a more plausible view. Recent studies on the ostrich afford strong evidence that the wings of its ancestors were much better covered with feathers than is the case to-day. There has been retrogression, and it is still continuing. The 42-plumed wing is a survival of an ancestral condition. Very interesting facts are communicated in regard to the retrogressive or degenerative processes which are still going on in the ostrich's wing. The retrogression proceeds in one part of the wing quite independently of the other parts. Thus, apart from the plumes altogether, the third finger shows retrogression. It is almost buried in the flesh, and the claw which some books describe has never been found on the hundreds of birds coming under Prof. Duerden's observation. But a study of the plumes lends no countenance to the common view that degeneration takes place by slow, continuous stages. There may be the full presence of particular plumes in one individual, and their total absence in others; but there is not a gradual passage from full expression to the vanishing-point. The degeneracy of an organ may stop at any stage according to the number of constituent factors which happen to be lost. We are apt to think of the degeneracy as a somatic affair, whereas it is germinal.

As to the possibilities of the 42-plumed survival, no chicks have yet been produced from the 42-plumed cock mated with a hen with the same number of plumes, for no hen has been forthcoming. But a score or so of chicks have been reared from the 42-plumed cock crossed with different 36-plumed hens, and these showed an interesting series of numbers from 37 to 43. It seems probable, therefore, that if the 42-plumed cock had been mated with a 42-plumed hen there would have been a full 42-plumed progeny. If similar 42-plumed survivals occur, it should be possible for farmers to increase by as much as 25 per cent. the crop of feathers from the same number of birds, or, a more desirable outcome, to procure the same quantity of plumes from three-quarters of their present number of birds. Prof. Duerden is to be congratulated on reaching conclusions at once of high theoretical interest and great practical utility.

Production of Pyrethrum Flowers in Japan

The peculiar properties of pyrethrum flowers, a variety of chrysanthemum (*Chrysanthemum parthenium*) which, when dried, are deadly poison to insects, while at the same time harmless t ohigher animal life have made these flowers a very valuable insecticide.

Like a great many other industries in Japan, the production of pyrethrum flowers and manufacture of insect powder greatly increased during the war. Prior to 1914 the chief source of supply was Dalmatia, Persia, and some parts of southeastern Europe; but during the past four years practically the world's supply has been produced in Japan. The first marked increase in production was in 1916, when the total weight of dried flowers reached 4,368,850 pounds, as against 2,190,365 in 1915. Before this time there was a gradual increase in production, but until the war stopped production in other countries this increase was not marked.

The production for the years 1917 and 1918 amounted to 6,845,208 and 6,720,000 pounds respectively but in 1919 it fell off to 2,479,680 pounds.

The center of the pyrethrum-flower production in Japan is in the Okayama and Wakayama Kens (Prefectures) in the Kobe consular district, practically the entire exports being shipped out of the port of Kobe.

The average size of Japanese farms is about 2½ acres, and the average field devoted to pyrethrum flowers measures about one-third of an acre. These fields are uplands (as distinguished from paddy fields) and, owing to their small size, as well as to the limited amount of capital on which the farmers operate, are entirely prepared and crop harvested by hand. The are entirely prepared and crop harvested by hand. The average production per acre is about 651 pounds.

The cost of production has been estimated at about 34 to 37 cents per pound, excluding labor, the largest factor in this expense being fertilizer. A comparison of the returns per acre from pyrethrum flowers and from two other principal commercial products of Okayama and Wakayama Kens, based upon August market prices, shows: Peppermint, $600; grasses for straw braids, $260; and pyrethrum flowers, $240.

The pyrethrum plant is a biennial, dying out at the end of the second year, and its production prohibits the use of land for other purposes during the same year. On the other hand, grasses raised for straw braids are produced in addition to a food crop, so that the return per acre planted in grasses is greater than that shown above. For this reason, as well as because of the shortage of foodstuffs, many farmers formerly producing pyrethrum are turning to straw for braids.

In the year 1913 the largest foreign purchaser of the Japanese flowers was Great Britain, which imported 184,930 pounds, while China purchased the largest amount of insect powder, 77,084 pounds. During that year the exportation to the United States amounted to only 30,736 pounds of flowers and 16,027 pounds of powder. In 1918, however, the United States was by far the largest purchaser of flowers, exports to that country amounting to 2,721,993 pounds, or 84 per cent. of the total exportation. China, however, is still the leading purchaser of insect powders, exports to that country amounting to 206,682 pounds in 1918, while the export of powder to the United States amounted to but 120,949 pounds, or about 14 per cent. of the total exportation.

The present shortage of product in Japan has gradually forced up the price, until flowers now stand at about $500 per long ton above the price ruling in January, 1919.—From *Commerce Reports*.

Future of the Draft Horse*

Taking Lessons from the Tractor Manufacturer in Developing the Equine Motor

By Mayne Dinsmore, Secretary of the Percheron Society of America

DURING the four years past, while the most tremendous conflict known to mankind has been going on, horses and mules have been indispensable. Our horses were in the war long before our men were. The British have been frank to admit that they would have suffered grievous defeats in the third year of the war if they had not possessed ample supplies of horses and mules, drawn from the United States, with which to put men, ammunition and guns where they were needed, when they were needed; and horses have never failed to go where men dared to ride them.

Success with horses or mules demands good horse sense in the owner. Where I find men complaining that they are not getting good results from their horses or mules and I go and check up their troubles I find that they usually lack the sound horse sense a successful man is sure to possess. It reminds me of the British officer, who in censoring home-going letters ran across one written by a private in his command. This fellow wrote to his sweetheart that he liked everything except the horses and mules. He said the horses were dangerous at the front end, worse at the hind end, and bad in the middle. As for the mules he said, "These mules make friends with you until they get you where they can kick you just right." The major said, "I went down to the stables to see how the fellow handled horses and mules, and after watching him for a while I longed to be a mule."

In considering the future of any industry it is necessary to consider the past and the present.

For forty years past heavy draft horses of approved type have always been salable at prices which left a fair profit when the work they rendered on the farm was taken into consideration. Even in the 90's, when all values were at a low ebb, this was true, for the feed needed to produce horses was absurdly low in price. Draft horses have been the easiest for the farmer to produce, have rendered the greatest service during their period of growth, and have enjoyed the widest and most stable market of any class of horses ever produced.

During the four years of war recently ended draft horses have brought the highest prices both here and abroad, and have been most readily sold. Today they are bringing more money than any other class of horses and can always be sold at some price. The only complaint heard is that they do not bring as high a price proportionately as other products of the farm. This is true, but it has also been true of other farm products at various times in the past, and it will be true in the future of other things than horses. Lack of ship space has been the chief contributing factor, for when horses were worth from two to three times as much in Europe as here we could not export them because all available boat space was needed for munitions of war (including horses) and men and provisions. We were in much the same situation as the wheat growers of Australia, who, with millions of bushels of grain in their granaries and a world clamoring to be fed, could not transport it to the nations crying for food, because ship bottoms were more urgently needed elsewhere. Today the same condition retards our trade, for provisions must go first to the European nations that have had less than a normal allowance of foods necessary to life. Construction work in this country has not had time to start, farm work is at the lowest point of the year, and feed stuffs are high. The net result is that everyone with surplus horses wants to sell; trade is stagnant, and prices are from 25 percent to 40 percent below true values, measured by the world's need for horses and mules. Such is the present situation; yet even today at any well-advertised farm sale, big, sound draft horses ready for work will bring good cash prices; not as much as they should, in proportion to other classes of livestock, but nevertheless prices that will leave a profit when the cost of the feed they consumed is reduced by a fair allowance for the work they have done on the farm.

As farmers and horse breeders we have four main problems confronting us in the immediate future. These, in the order in which I shall discuss them, are: Tractor and truck competition; increasing the efficiency of horses as power units; reducing their cost of production and maintenance; and the foreign demand for horses.

*Address before the Kansas Agricultural Convention

The competition of trucks and tractors has had a distinct influence. It has frightened thousands of farmers into a partial or complete discontinuance of horse breeding. Where it inhibited the breeding of mares of 1,200 pounds or over to draft stallions this has been harmful. Where it stopped the use of small stallions or the breeding of very small or decidedly inferior mares it has been a benefit. More good than harm has probably resulted, for we had a vast surplus of horses ranging from 1,000 to 1,400 pounds, and horses as a whole were being produced more rapidly than demand warranted. Especially was this true of the smaller, inferior kinds. A surplus of inferior horses drags down the price on good ones, so that every man who is producing good horses has reason to thank any factor which materially retards the breeding of scrubs, even though the same factor may temporarily depress interest in the production of real drafters.

How far truck and tractor use may limit the field for drafters in the future no one with certainty can foretell. We do know that in the large cities trucks and teams appear to be reaching a balance. Teams are cheaper and more effective in short hauls, trucks superior in the long hauls. For a time trucks replaced teams at a very rapid rate in our large cities. Chicago, especially favorable to truck usage, has exact data on this. During the three years ending April 30, 1915, two-horse teams decreased 15 percent, three-horse teams 30 percent, and auto trucks one ton or over increased 441 percent. During the next three years, ending April 30, 1918, two-horse teams decreased 21 percent, three-horse teams only 8 percent, and auto trucks over one ton increased only 174 percent—less than half as rapidly as the preceding period. Furthermore, there was an increase of 2 percent in the three-horse teams in the last year, and this tallies with the statement of very competent draymen, who stated that there had been a tendency on the part of some firms to swing back to heavy drafters for more of their short-haul work, for reasons of economy. In Greater New York there was during the two years and four months ending in March, 1917, a reduction of only 2,100 horses, despite a great increase in trucks. This was a decrease of less than 2 percent.

The limit of profitable replacement appears to have been reached, or nearly so, and not 30 percent of the heavy drafters have been displaced. The most experienced city transfer men, who have been in the business for twenty years or more, declare that teams can never be entirely eliminated in city work by trucks, as the increased cost of handling short-haul traffic would be prohibitive; and these are men who have both trucks and teams in constant service, do draying on a tonnage basis, and are interested in the proposition solely from a financial standpoint.

Tractor competition to draft horses on farms is a newer development, and has not yet reached its limit. The use of tractors will continue to increase up to the limit of profitable replacement, wherever that may be, and the farm power question will then go into a balance between tractors and horses, just as in our cities. The proportion of horses displaced on farms, however, will be much less than in the cities, for there are many factors on the farm which do not exist in the city to retard the use of gas-engine power units. Among these the more important are soft ground, lack of skilled mechanics, distance from repairs, and the higher cost of gas, oil and repairs. Horses also cost less, whether reared or bought, and are maintained at a much lower cost, especially as regards shoeing and feed.

From a working standpoint the horse must be considered simply as an equine motor—self-producing, self-repairing, and capable of utilizing the fuel produced on the farm. The tractor manufacturer seeks to make his machine as efficient as possible by using the best material in its creation. He also seeks to secure the most advantageous line of draft, so as to avoid all needless loads or strains, and tries to eliminate all weak spots which may cause breakdowns or shorten the life of the power unit. Horsemen should apply the same principles to their equine power units; in fact, must do so, if they are to make progress.

SIDE DRAFT

First and foremost we must learn to hitch our horses to various farm implements in such a way as to avoid side draft, which has been a constant drag on our power, especially plowing. It is impossible to hitch three or four horses abreast on a single-bottom plow or four abreast on a gang plow without creating side draft, unless one of the horses works on the plowed ground. This much has been definitely demonstrated in the experiments carried out during the past season by Professor White of the Illinois Experiment Station. The increase in traction due to side draft where four horses were hitched abreast was 25 percent under the best conditions, and sometimes considerably more.

Without going into details here, I may say that we have, working with the Illinois Experiment Station, evolved a hitch known as the "multiple hitch," which entirely eliminates side draft. The teams in plowing are hitched one in front of the other, and from two to five pairs may be used strung out tandem, just as handily as an ordinary farm-horse team. In this hitch, also, we have eliminated the fault of an unsatisfactory angle of trace on the teams removed some distance from the load, which has heretofore been the stumbling block of those who sought to use their teams strung out in this fashion, and to these tandem hitches we have applied the "tying in and bucking back" system, which has been successfully used for the past twenty years on the Pacific Coast. The general application and use of these improved methods of hitching and driving teams in four-, six-, eight-, or ten-horse units will go far toward increasing our draft-horse efficiency to a point where side draft will be wholly eliminated and the work done per week per man employed brought higher than with any three-bottom tractor.

Horsemen must also learn to build better draft horses, that will work with less time off for repairs and last longer than the average horse now endures. The horse that lacks endurance and that "plays out" when in hard work must be eliminated from the reproductive ranks, and the same holds true of those that go lame because of some structural defect. A mare that must be laid off because of lameness or lack of endurance in hard work should be discarded as a breeder, for she has faults that reduce her usefulness, and these will inevitably appear in her descendants in more or less degree. The farmer who uses unsound stock, or animals that lack endurance and courage when put to the test, is like the manufacturer who deliberately uses inferior materials in an engine. Both are contributing to a product that may break down and be laid out for repairs at an inopportune time. Here, then, we find in tractor competition a lesson which we may all take to heart; for our object, like that of the manufacturer, is to produce a power unit that will require no time off for repairs, that will give long life and steady service under all conditions. In this particular the Percheron breed has an enviable record, due undoubtedly to the fact that it has been the common practice, both in France and America, to work the mares. Farmers in both countries have, without realizing it, discriminated against mares that went lame or were unsound or that were ill-tempered or that lacked endurance. Such mares have been rejected instinctively, and have drifted to the cities or to other places where they were not used for reproduction; so that there has been a process of natural selection at work in the breed which has increased the value of Percherons as equine motors.

It was the superior endurance, activity and docility of the Percherons, grade or pure-bred, on the battlefields of Europe that first attracted the attention of British army officers, who have given the breed unstinted praise; and it is these characteristics that have made the Percheron the premier draft breed of the world, now numbering more than 70 percent of all America's pure-bred draft horses. Despite this clear superiority of the breed as a whole for power purposes, there is a considerable percentage of animals, even among pure-bred Percherons, that are not up to the desired standard, and these, whether stallions or mares, should be rejected. Service is the main test—and every farmer can judge of this with ease. The mare that is always ready for work, and that steps freely into the collar at the end of a hard day's work is a safe one to keep; and if her colts are of such conformation and size as to sell readily, hold fast to such a matron and her daughters, for they will make you rich. This is the surest and shortest road to increasing the efficiency of our equine motors.

The watchword in every factory is, "Reduce the cost of production without lessening the quality of the article." In this we, as farmers and horsemen, have much to learn from manufacturers. A factory in which one-half the lathes stood idle would soon face bankruptcy; yet there are many farms where at least one-half the mares are barren each year, not because they will not breed, but because the owner was too careless or indolent to put them into good breeding condition and to make sure that they conceived. The first step in reducing the cost of production on an individual farm is, therefore, to see that every mare of breeding age brings forth a colt each year.

The next step in the factory is to bring the rough product first turned out from forge or foundry through to a marketable point without loss. A factory that broke half its engine castings while they were being machined and finished would soon be ruined; yet on thousands of farms from one-third to one-half the colts that are foaled are lost from navel ill or some other avoidable ailments before reaching maturity. Our second step in reducing the cost of production is, therefore, to take every human precaution against the loss of colts between birth and maturity. Some loss will inevitably be encountered, for disease sometimes comes in both man and beast that defies all precautions our knowledge can suggest; but the reduction of costs makes it imperative for us, as farmers and horsemen, to learn all we can about preventing these ailments which take such a toll at times from our colts.

The third step in cutting costs is found in the feed problem. This may be likened to the labor problem of the factory. Inefficient labor, or labor improperly coordinated, increases factory costs; and poor feeds, or a faulty combination of good feed stuffs, increase the cost of production in our horses.

First and foremost in reducing cost of product I would put good pastures. Prof. J. L. Edmonds, of the Illinois Experiment Station, has a group of pastures that have for the past two years carried an average of one horse per acre the year round. This has reduced the cost of production both by lessening the acreage needed and by reducing the labor required to feed and care for the growing colts. He has built these pastures within ten years from a rough cornfield to a point where they cannot be excelled in America; and what he has done any farmer can do, for he has used only common sense, close attention, and fertilizers, available to anyone.

Second only to pasturage, I place the use of roughage in an intelligent way. Our experiment stations have many sins to answer for, but in no one thing have they been more guilty of sins of omission than in studies relating to the best use of economical roughages for growing or maintaining horses. This question, with that of grains, should receive exhaustive study from our experiment stations. Only one or two are now at work on these questions, and few have contributed anything of consequence on horse feeding. Horsemen must write to their experiment stations and insist on some worth-while work on these subjects.

In the meantime we must go to the experience of some of our best horse raisers for light. These men are using a variety of roughage, such as corn fodder in the morning, oat straw at noon, and alfalfa or bright clover hay at night. All roughages used must be free from dust. So far as grains are concerned there is nothing better than oats, but a combination of grains may often give cheaper production cost without impairing the rate of growth or quality of animal produced. It is here, however, that we need some comprehensive experimental work involving large groups of animals, carried through from birth to maturity, for the specific purpose of ascertaining what grain combinations can be used with cheap roughage without retarding normal growth. I urge you to impress upon your own experiment station the importance of this work, for several years' tests must be ended before any definite conclusions can be drawn. These tests should by all means involve combinations of grains which can be grown on every farm, so that, if possible, rations can be evolved independently of purchased products.

Foreign demand is a problem which no man can as yet measure. It was anticipated that there would be an immediate and large demand for our horses in England and France; but letters which I have recently received from men in Great Britain who are especially well qualified to speak with authority indicate that there will be no immediate demand for our commercial horses there. In the first place they are so short on horse forage that ration cards have been issued, and the amount each horse can have is doled out with even greater care than sugar was to human beings. In the second place, the British Government is now selling 125,000 horses from the army in Great Britain, and will, it is estimated, sell half a million more within the next eight months. The London *Times*, on December 11, 1918, quotes Sir William Birkbeck, Director General of Remounts, as having estimated in a speech made December 10, 1918, that the number of horses eventually to be released from the British armies would be not less than three-quarters of a million. General Birkbeck also proved by the exact records of the army that the percentage of wastage among army horses, even allowing for war losses, was considerably less than that experienced by ordinary commercial firms in Great Britain before the war. Brood mares released from the army are to be sold to British farmers, but the government retains a lien on the progeny up to three and one-half years of age, at $250 per head.

The number France will demobilize is estimated at nearly three-quarters of a million, and the United States government had at the time the armistice was signed 166,564 horses and mules in Europe, all of which will be sold there within the next two or three years. This means that there will be approximately one and a half million horses released from the allied armies for other uses in the next year or two; and such a demobilization will forestall any extensive exportations and rapidly reduce values from the higher levels prevailing in Europe to figures more nearly approximating prices here. There is, however, definite evidence in my possession which forecasts the inauguration of some shipments of heavy drafters from the United States to Europe as soon as cargo space is available at reasonable rates; and there is also certainty of some exportations of Percherons from the United States to Great Britain, as three separate British concerns are already at work on preliminary plans for Percheron purchases in this country. These will be very strictly safeguarded by the British Percheron interests, which have already given notice that they will not allow any shipments unless the animals are inspected and passed before leaving the United States by their own representatives. Knowing, as we do, the harm which came to American horse interests by the importation from France and sale here of many inferior Percheron stallions, we can but applaud the good judgment our British cousins are displaying in taking steps to check the activities of irresponsible speculators who might seek to engage in the trade. The demand for Percherons in England will grow, slowly but surely, as they acquaint themselves with the merits of the breed; and there is reason to believe that the trade will eventually be almost as important as our sales to Canada, which totaled 770 Percherons during our last fiscal year.

Despite the conditions I have already discussed, which will delay the establishment of a large trade in the exportation of horses, there is bound to be a great volume of business in exporting horses within the next five years. Even New York financial journals have taken note of this, for the *Wall Street Journal* recently said: "Nothing on the American farm will be in greater demand abroad than the horse."

All this must favorably affect the future of the draft horse here.

When all is said and done, horsemen must realize that the horse will survive as a power unit so long as equine power can be furnished more cheaply, more efficiently, and more satisfactorily than in some other form. Horses today furnish the greatest proportion of the power needed in producing crops, and there is no reason to believe that the supremacy of the good draft horses on farms ever will be threatened seriously; but inefficient horses, and their owners, will be slowly but surely eliminated.

The advantage to the farmer of producing his own power units is very great, for then he is independent. Tractor manufacture requires labor in the iron and coal mines, steel mills, and tractor factories, and much of this is high-priced labor. Strikes or wage increases may within a very brief time double the loss of power to the farmer who is dependent on the factory, and he is subject to the arbitrary action of manufacturers in the prices he must pay for repairs and the time when he shall receive them. The cost of fuel is also beyond his control. The man who uses draft mares and rears his own power units is free from such problems. He knows that the cost of his power units cannot be suddenly and arbitrarily increased by the action of a manufacturer or labor union. He knows that he has no need to fret about repairs, for if one horse gives out another can be substituted in thirty minutes or less; and he is raising his own fuel in roughage and grains and can tell the Standard Oil Company where to go when the price of internal combustion oils is increased.

We must not forget, also, that while the horse in ordinary work exerts a pull equal to one-tenth his weight, he can in an emergency pull a load five or six times as great, while mechanical power at best can pull only a 100 percent overload. This reserve of power available in horsepower units is invaluable on the farm or anywhere else when thoroughly dependable power that can work in soft footing is needed.

Furthermore, the waste from his equine power units goes back to the farm as fertilizer instead of being sold to the old junkman at half a cent a pound; and last, but not least, his power units in horseflesh endure much longer than any other field power he can buy.

The good draft horse will reign supreme on farms, and will continue to do so; but the inefficient horse is doomed.

Street Lighting and Traffic Accidents

By Ward Harrison

An exhaustive survey has been published* showing that improper or inadequate lighting is at least a contributing cause of 24 per cent of our industrial accidents. There are, however, no definite data available which show how many of the traffic accidents on city streets are due to this cause. The following survey of 3549 traffic accidents, shown on the records of the Police Department of the city of Cleveland, for a period of one year will therefore be of some interest.

The purpose of this survey was to determine, if possible, how many of the 1059 accidents which occurred after dark would have been avoided if daylight or its equivalent had been available. The simplest way of making such an estimate would be to compare the accidents which occur between, say, 5 and 9 p. m. in mid-summer when daylight is available, with the number for the corresponding hours in mid-winter when it is dark. The records actually show that there were 157 accidents between these hours in June and July, while for December and January the total was 193, or about 22 per cent more.

There are, however, several other variables beside the question of daylight and darkness which one must take into consideration when comparing accidents in winter with those in summer. For example, there are as a rule very many less vehicles on the streets in mid-winter, hence less liability of accident; on the other hand, this factor is counterbalanced to some extent by the effect of slippery pavements. It is necessary therefore to separate out these other variables before we can decide upon just how many of the 193 accidents on mid-winter evenings should be attributed to lack of light. Obviously, we can find the relative effect of all these other factors, except lighting, by comparing the number of accidents which occur during the middle of the day in winter months with those in the summer months or, for that matter, those that occur in the middle of the night at both seasons of the year. On this point the records show for December and January 21½ per cent less accidents between 9 a. m. and 4 p. m. than during the same hours for June and July, and they also show 8½ per cent less accidents for the winter months during the hours that were dark at both seasons, viz., from 10 p. m. to 5 a. m. We are justified therefore in stating that, except for the question of light, there would really have been fewer accidents between 5 and 9 p. m. in the winter months than for the corresponding summer months. To be exact, instead of 193 accidents in the winter for every 157 accidents in the summer, we would have found 140 accidents in the winter had it not been for the lack of daylight. In other words, there were 53 accidents which can be attributed directly to lack of light. If we apply the same proportion, viz., the ratio between 53 and 193 to the total number of accidents occurring after dark in Cleveland during the whole year, we find that 292 of them are to be attributed to lack of light, and of these at least 14 must be classed as fatal accidents.

It of course seems out of the question today to provide street lighting which is as effective in preventing accidents as daylight itself. It is nevertheless interesting to contrast the difference in accidents in the White Way district of the city with the number occurring in other portions. In this case, however, the total number of accidents involved is so small that the figures can only be taken as indicative. In the White Way district there were 20 accidents in summer between 5 and 9 p. m., and 21 in winter; whereas, the proportion for the city as a whole for these hours would indicate 25 accidents in the winter to every 20 occurring in the summer. We are safe in saying, therefore, that the higher intensity lighting in the White Way district has had a marked tendency to reduce accidents.

Coins of the Ages—II

An Illustrated Historical Description of the Coins of England, France, Germany, the Orient and America

By Howland Wood, Curator of American Numismatic Society

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GERMAN COINS

113.* Saxony. Gold gulden struck at Leipzig by Albrecht the Courageous, about 1500.

114. Ducat struck at Vienna by Ferdinand I. while the city was besieged by the Turks in 1529.

115. A gold gulden struck by Anton Fugger of the famous Fugger family, which had acquired an enormous fortune in commerce. The right to coin money was granted to this family by Charles V. in 1534.

116. A burial ducat of Johann Philip of Saxe-Altenburg, 1639. German princes were in the habit of striking coins commemorating births, baptisms, marriages, deaths, etc.

117. A ducat struck by the famous general, Albert of Wallenstein, as Duke of Friedland and Sagan.

118. A ducat struck by the city of Frankfort to pay the indemnity to the French troops in 1796. The gold used was from melted down church plate. A view of the city is shown on the coin, which is similar to previous issues, but on this coin the usual shining sun in the sky is covered by a cloud.

As will be seen by the gold coinage, the German series is replete with odd designs. The silver dollar or "thaler" series is especially picturesque, as each petty subdivision of the Empire issued its own coinage, all bearing their own peculiar devices.

119. The Joachims thaler, issued by the Count of Schlick in the first part of the 16th century from silver of the Joachimsthal mine. The word thaler and our word dollars are said to have originated from this name, though pieces of this size had been coined long before.

120. An early dated thaler of Bern bearing the date 1494. Very few coins were dated before the 15th century and it was not common to date coins during the next century. The use of our present figures was not general in Europe much before 1500.

121. The bell thaler of Augustus of Brunswick-Wolfenbüttel, struck in 1643. There are several varieties of these and they have a political significance.

122. Teutonic Order, a thaler issued by Maximilian, Archduke of Austria, while Grand Master of the Order.

123. Struck by John George II. of Saxony to commemorate the shooting match held on the occasion of the baptism of his grandson, who is here pictured as the infant Hercules strangling the snakes.

124. A mining thaler of Fürstenberg, showing a view of the mines. Pieces of this type are not unusual.

125. A thaler of the city of Cologne, picturing the legend of St. Ursula and the 11,000 Virgins.

126. A coin of Landau, struck during French occupation, while the city was besieged by the Imperial forces in 1702. This piece is interesting, as it shows the turned-up edge of the silver plate from which it was made.

127. The "brand" thaler struck at Thorn in 1629 to commemorate the brave defense of the city by the Swedes.

128. A thaler struck at Herborn by the five princes of the different branches of Nassau.

129. The "Levant" thaler of Maria Theresa, first struck in 1780 for Austria, but soon introduced into Arabia and Abyssinia, where it is still used. To meet the demand these pieces, identical in every respect, including the date, 1780, are still made by the Austrian government.

130. A thaler of Transylvania, when independent, struck during the siege of Cronstadt. The utter despair of the inhabitants for deliverance is expressed on the piece by the legend, which can be translated, "From the depths of our hearts we call upon Thee, O Lord, to save us lest we perish."

ENGLISH COINS

131. A silver penny of William the Conqueror (1066-1087).

132. Gold noble of Edward III. The King here is depicted in a ship. The reverse is similar to 136.

133. Groat or four penny piece of Henry VI. (142 1461). This is the general type of the silver coins of the period.

134. A silver penny, showing the general type before Henry VII.

135. A gold coin known as a chaise d'or, struck at Antwerp, in the name of the German Emperor Louis the Bavarian, probably by Edward III. of England, who occupied the city in 1338.

136. The reverse of the gold nobles (see 132). The type is Gothic and was extensively copied.

137. An angel of Henry VII., so-called from the representation of the Archangel St. Michael slaying the dragon.

138. A portrait half sovereign of Queen Elizabeth.

139. A unite or gold 20 shilling piece struck at Oxford by Charles I.

140. A shilling struck at Pontefract Castle in behalf of King Charles I. by the defender, Colonel Morrice, while besieged by Cromwell, 1644-1648.

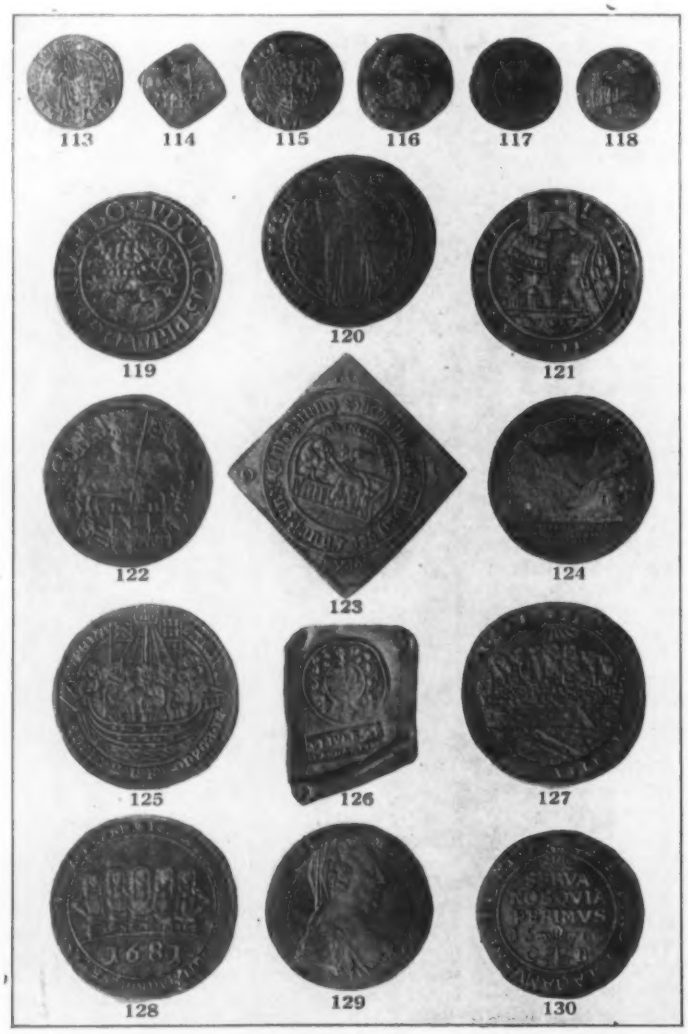
141. A gold broad struck by the Commonwealth of England in 1653 at the Tower of London.

142. A half crown, showing a remarkably fine portrait of Cromwell.

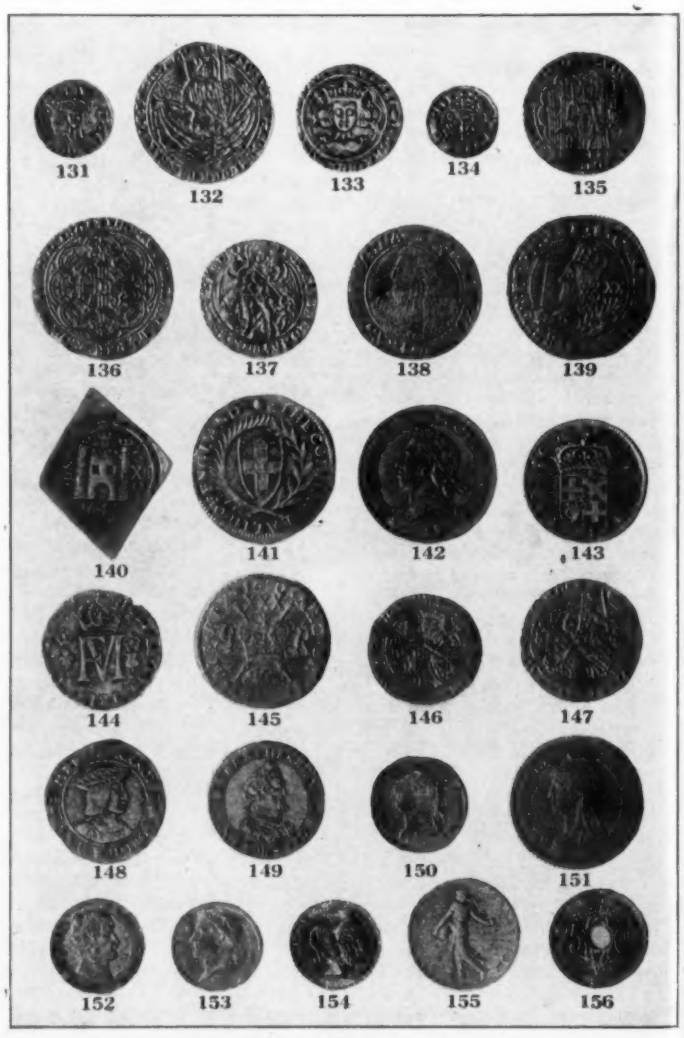
143. The reverse of the coins of Cromwell, showing the return of the royal crown above the arms.

144. A Scottish teston of Mary Queen of Scots and Francis, her first husband.

* Numbers correspond to those under engravings of coins described.

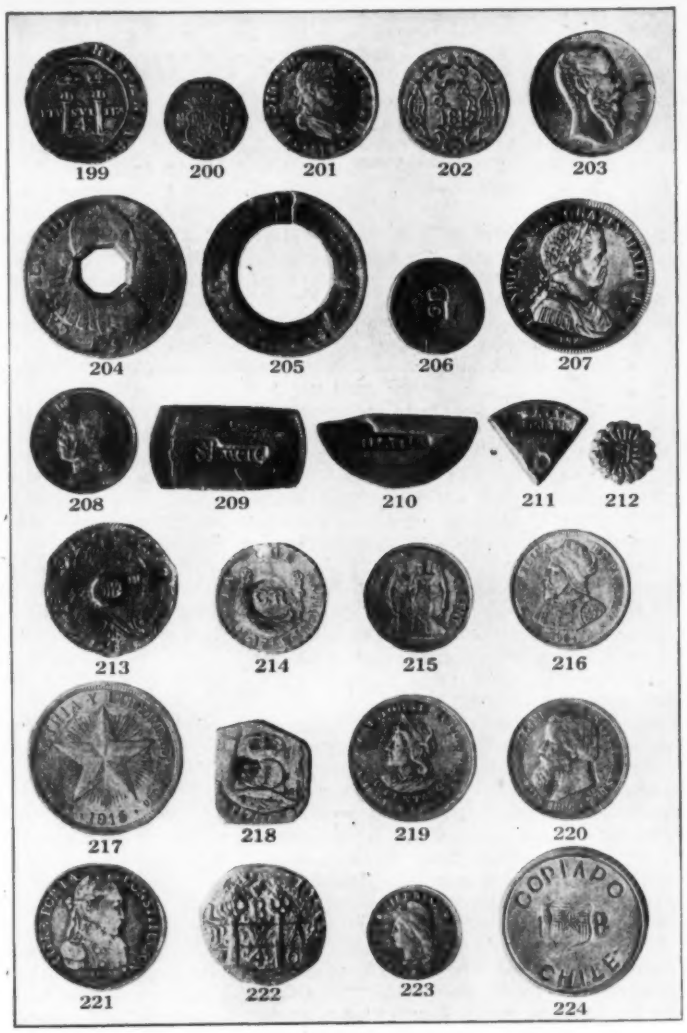


German Coins

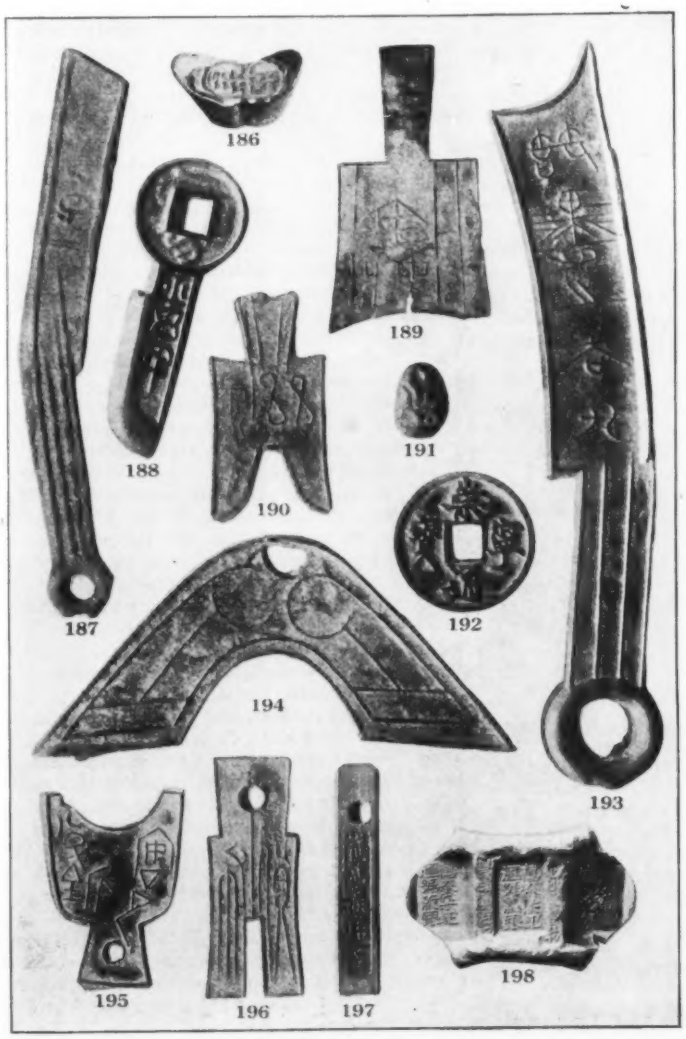


English and French Coins

Orientai Coins



Latin American Coins



Chinese Coins

United States Coins

145. Bronze 30 penny piece struck in Ireland by James II. while at war with William of Orange. These coins were called "gun money."

146. A gold salute, struck by Henry VI. of England (1422-1461) while he held dominion over parts of France. This piece was struck at Rouen.

FRENCH COINS

147. Gold franc à cheval of John the Good (1350-1364).

148. Picturesque portrait teston of Francis I., struck at Poitiers (1515-1547).

149. An extremely fine portrait coin of Henry of Navarre, struck at Paris in 1607.

150. A 15 sou of the ill-fated monarch, Louis XVI.

151. Copper 2 centime piece of the First Republic.

152. Franc of Napoleon Bonaparte as First Consul.

153. A 20 franc piece of Napoleon as Emperor.

154. The "Coq Gaulois," the reverse of the present 20 franc piece of France.

155. The present type of silver money of France, showing "The Sower," by Roty, considered the handsomest of modern coins.

156. Type of the present French nickel coins. The hole in the center is to make it easily distinguishable from the silver coins.

ORIENTAL COINS

The Mohammedan series of coins began within a comparatively few years after the death of Mohammed, and was a very abundant coinage in gold, silver and copper. On account of a Koranic law forbidding the making of representations of living things, the coinage consists largely of inscriptions, but there are many and frequent exceptions. Although to the average collectors the coins lack interest, being for the most part written in Arabic, they are valuable historical documents to the student, as the year of issue, mint and generally the ruler is on them.

157. Silver dirhem struck by Caliph El Welid in 713 A. D. at Wasit. The inscription on this and most early Mohammedan coins is interesting. "This dirhem, struck in the name of God at Wasit in the year 94 (Mohammedan era). There is no god but God, who has no associate. God is alone, God is eternal, He begets not and is not begotten, nor is there like unto him anyone. Mohammed is the prophet of God, sent with guidance and the religion of truth, to make it prevail over every other religion, averse although idolators may be."

158. A dirhem of the Abbasside Caliph Haroun al Raschid, familiar to readers of the "Arabian Nights."

159-160. The style of dirhems the Arabs struck in Persia. Both the obverse and the reverse were copied from the coins of the Sassanians, who were their predecessors.

161. A crude looking coin struck at Bokhara about 760 by Mohammed the Mahdi, mentioned in Moore's poem, "Lalla Rookh."

162. A dirhem struck in 1018 in the Castle of Ceuta, during the Arabic regime in Spain.

163. A silver coin struck by the famous conqueror, Mahmood of Gazni, referred to in the "Rubaiyat" as "Mahmud on his golden Throne."

164. A coin issued by the Seljuke Sultan Kay Khusru, son of Kay Kubad, also mentioned in the "Rubaiyat." The lion and the sun are said to be placed on the coin in honor of the beautiful Georgian wife of the ruler.

165. A dirhem of the well-known Saladin the Great, who captured Jerusalem and provoked the Third Crusade.

166. A small silver coin struck by Janibeg, one of the khans of the Golden Horde.

167. A coin of Timur, better known as Tamerlane.

168-169-170. Copper coins struck by Turkoman tribes. These invariably have figures on them, some original, others copies of Greek, Roman and Byzantine coins. No. 169 has an undoubted portrait of Nero (see 36). The sorrowing figures on 170 are supposed to represent the grief of the Moslems on the occasion of the death of Saladin.

171. A gold tilla struck by Yakub Beg, the Atalik Ghazi of Kashgar, in 1874. He did not place his own name on the coin, but that of his religious suzerain, the Turkish Sultan.

172. A copper beza of the Mohammedan Sultan of Zanzibar.

173. A piastre or dollar struck by Sultan Selim III. of Turkey. The inscription is very high sounding: "Sultan of the two lands and khakan of the two seas, sultan son of the sultan."

174. A peculiar shaped coin struck at Isfahan by the Persian Shah Husein. This shape coin was not uncommon in Persia.

175. Five franc piece struck by the French for their protectorate, the Comoro Islands. Evidently the personal vanity of the ruling sultan was considered in the design.

176. A twenty piastre piece imitating the Turkish coinage struck by the Mahli at Omdurman in the Sudan in 1884. It was these dervishes that General Kitchener finally defeated.

177. A square rupee of the Moghul Emperor Akbar of India. These square coins are held in great reverence by the natives of today for their talismanic effect.

178. One of the famous Zodiacal gold mohurs struck by Jehangir. This piece bears the sign of Sagittarius. There are also pieces with all of the other signs of the months. There is a pretty story that these special pieces were struck by Jehangir's beautiful wife, Nur Jehan, but unfortunately the story cannot be proved.

179. Talari of Menelik of Abyssinia. This was issued largely to supplant the thaler of Maria Theresa, which previously was the only coin current in the country (see 129).

180. Rupee struck at Oudh in India.

181. Rupee issued by the Chinese for Tibet. The only Chinese coin bearing a portrait of the Emperor. It was issued to drive out the British Indian rupee.

182. The old form spherical tical of Siam, made by hammering a small bar of silver into this peculiar shape.

183. A more modern form of the Siamese tical, showing the national elephant on it.

184. A peculiar shaped copper coin resembling a canoe or dug-out, made at Luang Prabang on the Mekong River in Northern Siam.

185. A mark issued by Germany for its New Guinea possessions. It shows the bird of paradise.

CHINESE COINS

186. Cast silver ingot called a shoe and weighing a tael. Up to within a few years most of the silver money was in this form.

187. A knife-shaped coin issued in the city of Ming in Chili, 3d century B. C.

188. A more modern form of knife coin, issued in the Han period by Wang Mang, 7 A. D. The two top characters are in gold inlay.

189. One of the earliest forms, called spade money. The handle is hollow. They were cast at different places during Tchou dynasty between 680 to 350 B. C.

190. A degenerate form of spade money called "Pu." This piece was issued by the Tze clan in the old state of Tchao.

191. A small coin known as ghost's head or ant's nose money, thought to be imitated from the shell or cowrie.

192. The round or common form of money. This form is as old as any, but did not come into exclusive use until the Christian era, and was then used, with only the change of characters, to the present time.

193. A large knife coin of Tsih Moh on the Shantung Peninsula, issued about the 4th century B. C.

194. One of the earliest forms of Chinese money, 8th century B. C. The piece is uninscribed, the shape only being its guarantee.

195. Weight money. The inscription says "half kin of An Yh." About 4th century B. C.

196. A different form of "Pu" coin (see 190) of the ruler Wang Mang (see 188).

197. A token or tally made of bamboo. These have a local use for money in different parts of the country.

198. A curiously shaped silver ingot of private manufacture, used, however, for money.

LATIN-AMERICAN COINS

199. The earliest coin struck in America. A four real piece struck in Mexico City about 1516 by Charles and Johanna of Spain. The two columns (the Pillars of Hercules) became the usual device on Spanish coins struck on this hemisphere.

200. A real of Philip V., struck in Mexico. This is the general type of obverse until the time of Charles III., when the portrait was introduced.

201. A two real piece of Ferdinand VII., struck during the last years of Spanish rule in Mexico. This corresponded to our 2 bits.

202. A revolutionary coin struck by the patriot Morelos in Oaxaca in 1812, during the revolt against Spain.

203. A half peso of the ill-fated Emperor Maximilian of Mexico, 1864-1867.

204. A Spanish-American 8 reals, or "piece of eight," pierced by an octagonal hole on the island of Tobago. This custom of cutting silver coins was very common in the West Indies. The islanders, having no coins of their own, were forced to import Spanish money, and in order to keep them on the island mutilated the coins. The pieces thus cut out were used for small change.

205-206. A 12 and a 6 bit piece used on Dominica. This well illustrates the above remarks. 206 is the center of 205.

207. A double gourde of Haiti during the time Henri Christophe was King.

208. Nickel 20 centime piece of Haiti, with portrait of President Nord Alexis.

209. The manner of cutting an 8 real piece on the island of St. Lucia.

210-211. Other forms of cutting coins at Tortola and St. Martin.

212. The center portion of a Spanish peso, cut on Trinidad to pass for a shilling.

213. A Portuguese gold "Joe," stamped for use on Grenada and Trinidad, with a plug of gold added to make the weight conform with the islanders' standards.

214. The way the Spanish money was converted for use on Jamaica. This island did not mutilate the coins, but simply counterstamped the pieces.

215. A modern 2 franc or 40 cent piece for the Danish West Indies.

216. Quarter balboa of Panama. These coins are made at the Philadelphia mint.

217. The new Cuban peso, first introduced in 1915, and made at our mint.

218. Guatemala 4 real piece. Many of the Spanish-American coins were of rough outline, for as long as the weight was correct the mint authorities gave little thought to the looks of the coin.

219. A coin of Salvador with bust of Columbus.

220. A thousand reis piece of Brazil with portrait of the last Emperor, Dom Pedro II.

221. Four sueldos of Bolivia with bust of the liberator, Bolivar.

222. The famous Spanish-American doubloon. The roverse has a cross, with the lions and castles of the Spanish arms in the angles. The first was crude like this, but later were well-made round coins.

223. The type of the modern coinage of Argentina.

224. A crude peso struck at Copiapo in Chile during the Spanish blockade of the place.

UNITED STATES COINS

225. The Massachusetts pine tree shilling, our first "home made" colonial coin.

226. The reverse of one of these shillings. All of them are dated 1652, though they were made for a number of years.

227. The Rosa Americana twopence. A handsome coin made by England for use in the American colonies.

228. The reverse of a cent made by New Jersey shortly after the Revolution and before the Federal Government made its own money.

229. The first United States coin, known as the Fugio cent. It was made by private parties for the government and it is said that Benjamin Franklin conceived the design.

230. A five-dollar gold piece made by A. Bechtler, at Rutherford, North Carolina, in the '30s from gold mined in the region. This and the next four coins were made by private concerns, a practice unlawful today, but a necessity in those days.

231-232. Two types of coins made by the Mormons in Salt Lake City. These are now very rare.

233. The fifty-dollar slug of the gold mining days in California, a semi-official coin made in great quantities until our government opened the mint at San Francisco. Fifty-dollar gold pieces were again made and sold at the Panama-Pacific Exposition.

234. A gold bar made in California in the days of the pioneers, to pass for $16, or a Mexican doubloon.

235. A stella or $4 gold piece. This is what is termed a pattern or experimental coin, as it was never put in circulation.

236. The $3 gold piece, coined from 1854 to 1889. This is one of the handsomest of our coins and is no longer seen in circulation.

237. The first type of our double eagle or $20 gold piece. We coin more of these large gold coins than any other nation. First coined for circulation in 1850.

238. Our first eagle or $10 gold piece. The coin is

(*Concluded on page* 312)

Temperature of the Human Skin*

Change of Temperature in Artificial Cavities not Indicative of Change in Entire Body

By F. G. Benedict, W. R. Miles and Slice Johnson

NUTRITION LABORATORY, CARNEGIE INSTITUTE OF WASHINGTON, BOSTON, MASSACHUSETTS

THE clinical importance of records of body-temperature, as taken usually in the mouth and occasionally in the axilla or rectum, has quite obscured the physiological significance of the skin temperature. Extensive researches have shown that the temperature of the human body, deep in the body trunk or in any of the natural cavities, remains reasonably constant, although there is a diurnal rhythm, with a minimum value at about 4 A. M. and a maximum at about 5 P. M. Simultaneous observations of temperature at different parts of the body show that there is almost always a parallelism in curves for temperature. Thus, the temperatures in the rectum or vagina, the well-closed groin or axilla, and the mouth, show similarly shaped curves, although at markedly different levels.

The technical difficulties in recording skin temperature have undoubtedly retarded extensive study in this phase of body-temperature research. The temperature of the human skin is the resultant of several factors, as heat is supplied from the subcutaneous tissues and lost from the surface of the body by radiation, conduction, and the vaporization of water. An attempt to secure accurate records of skin temperature by the application of an ordinary mercury thermometer is obviously useless, for but a small proportion of the bulb of such a thermometer comes in actual contact with the skin. Even thermometers constructed with a special bulb providing a large surface to apply to the skin have a like surface exposed to the environmental temperature. If, as is occasionally done, this outer surface is covered with non-conductive material, there is almost immediately a disturbance in the temperature of the skin due to the fact that there is a retardation of the normal loss of heat, with a consequent accumulation of heat from the subcutaneous tissue. The true temperature of the skin should therefore be recorded by an apparatus which is nearly instantaneous in action and sufficiently protected from the environment to insure a true record of the surface temperature, and not a resultant of skin and environmental temperature.

A method recently used at the Nutrition Laboratory consists of two copper-constantan junctions, one located in a constant-temperature bath—a Dewar flask—and the other applied to the skin. The resulting current which can be measured on any one of several types of galvanometers is directly proportional to the temperature difference between the two junctions. All thermometric lag is thereby eliminated and it is only necessary that the junction which is applied to the body should be properly protected from the environmental temperature. It was found that when this junction was backed with a light tuft of cotton batting and installed rigidly in a piece of hard rubber, it was possible to apply it to the body and have it assume the surface temperature inside of a few seconds. Thus the period of application was so short that the protecting material did not sensibly affect radiation, conduction, or the vaporization of water.

In our ordinary skin temperature measurements, the junction in the constant temperature bath is kept at 31° or 32°C. When the other junction is exposed to usual room temperature, there is a large deflection of the galvanometer. On applying the junction to the surface of the skin, the amplitude of deflection decreases rapidly and with negative acceleration. The deflection level is reached in about six seconds after application of the junction. Thereafter the rate of movement of the galvanometer is extremely slow, being but a millimeter or two for each successive minute. The explanation of this is that the junction almost instantly assumes the true skin temperature. Thereafter the skin temperature gradually rises, as the protection of the junction with cotton batting and hard rubber stops the loss of heat by radiation, conduction, and vaporization of water, and there is then a "building up" of the temperature due to the subcutaneous source of heat. As a matter of fact, observations taken for some time show that this rising temperature continues, the length of time depending in large part upon the amount of hard rubber and cotton batting used. For all of our work we have assumed that under these conditions the true skin temperature is obtained at the end of about six seconds after application of the junction.

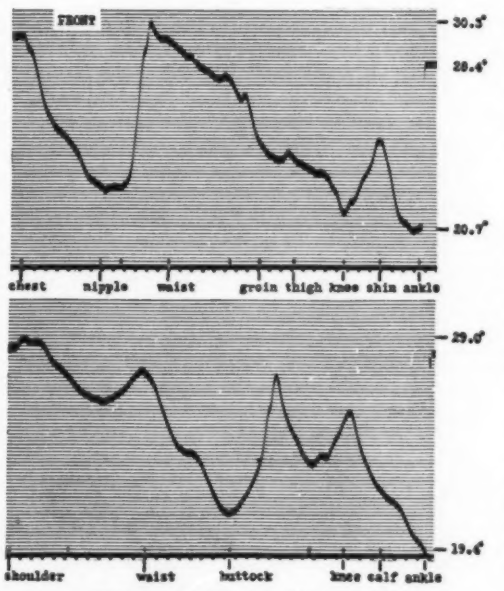
*Reproduced from *Trans. Nat'l. Acad. Sci.* Read before the Academy, April 28, 1919.

In connection with an extended series of metabolism experiments on the influence of temperature environment upon the metabolism, it was found that the subject used (a professional artist's model) could withstand exposure to temperatures as low as 14°C. for several hours without shivering. These conditions presented unusual opportunities for studies of skin temperature which would give evidence first, as to the rapidity of the change on exposure of the body to the environmental temperature, and finally as to the absolute level which the skin temperature reaches after prolonged exposure to an environment varying from 14° to approximately 30°C.

RECORDS OF SKIN TEMPERATURE UNDER THE CLOTHING

MEDIAN LINE		RIGHT SIDE		LEFT SIDE	
Location	°C.	Location	°C.	Location	°C.
Front		*Front*		*Front*	
Forehead	31.6	Neck	32.5	Neck	32.1
Second rib	30.3	Nipple line		Nipple line	
Fourth rib	32.1	Upper chest	33.6	Upper chest	33.7
Lower edge breast bone	33.2	Under breast	33.8	Under breast	33.7
7.0 cm. above umbilicus	34.4	Waist	34.4	Waist	34.7
3.0 cm. below umbilicus	33.4	Groin	34.0	Groin	32.8
11.5 cm. below umbilicus	31.8	Thigh	30.7	Thigh	31.1
		Shin	29.8	Shin	30.9
		Back		*Back*	
		Shoulder blade (above)	33.6	Shoulder blade (above)	33.7
		Shoulder blade (below)	32.5	Waist	33.7
		Waist	33.7	Buttock	29.9
		Buttock	30.5	Thigh	31.4
		Thigh	31.0	Calf	28.2
		Calf	28.1	Hand	32.3
		Hand	32.5		

When the subject arrived at the Laboratory, the clothing was loosened and temperature measurements were made at numerous points on the skin under the clothing. Prior to these records, the subject clothed and wearing a heavy coat had been exposed to an external temperature of about 17°C. The results of one series of measurements are recorded in the table. The extreme range in the skin temperature on this particular day was 6.6°C. Special attention is called to the relatively high value of 31.6°C. on the exposed forehead, the record of approximately 34°C. at the waist, a part well protected by clothing, and values of 30°C. or below on the buttocks, shin, and calf. This series is typical of the skin temperature of a normally-clothed woman.



Skin temperature of the nude body

Photographic records from a string galvanometer for skin temperatures at different parts of the nude body following a 2½ hour exposure to an environmental temperature of 14.6°C.

The thermal junction was moved at constant tempo from shoulder to ankle. Time registered at bottom of each curve is in 2-second intervals.

The method of using isolated points, such as those given in table 1, can be much improved upon by taking advantage of the fact that the thermal junction, when not excessively protected by the cotton batting and hard rubber, almost instantaneously assumes the skin temperature. This is particularly the case if the junction is moved from one part of the skin to another after the hard rubber and cotton have assumed approximately the temperature of the skin. When recording the values of isolated points, we have employed a good grade, direct reading galvanometer, thus making the apparatus compact and portable. The response of the thermal junction is so rapid, however, that when connected with a sensitive aperiodic instrument, i.e., a string galvanometer, it is perfectly possible to move the junction at a moderately rapid rate over the surface of the body and record photographically a continuous and true temperature curve for an infinite number of points on the skin.

To illustrate our many results obtained by this latter method, two typical curves are given in the figure. These were obtained after the nude subject had been exposed to an environmental temperature of 14.6°C. for two and one-half hours, the greater part of the time in the standing position. The upper curve follows the left mammillary line, while the lower curve was taken in a corresponding position on the back. An extraordinary difference in skin temperature at the different points may be noted, the extreme range on the front and back showing differences of 10°C. or more. The rectal temperature taken simultaneously was 36.7°C.

The pronounced influence of the environmental temperature upon the curve for the skin temperature was especially studied by making temperature photographs over exactly the same line at intervals from the moment of disrobing to the end of the period of prolonged exposure to cold. As would be expected, these show a progressive increase in the amplitude of the curve as the time of exposure is prolonged: marked changes occurring even inside of the first fifteen minutes. Similar studies made at the end of the exposure to environmental temperatures varying from 14° to 30°C. show a distinct tendency towards a flattening out of the curves at the higher temperatures. Thus when the thermal junction was passed down the front and back of the body over exactly the same lines and at the end of two and one-half hours' exposure, the difference between the highest and lowest points in the curves was 10.6°C. with an environmental temperature of 14.6°C.; 9.8°C. with a temperature of 19°C.; 5.4°C. with a temperature of 25.8°C.; and 4.2°C. with a temperature of 30°C.

This study of the temperature of the skin has two important bearings upon all investigations on the heat production of the human body. First, in all researches on direct calorimetry it has been necessary to correct the heat actually measured by the calorimeter for the heat gained or lost from the body as the result of changes in temperature. Heretofore it has been assumed that as temperature curves measured either deep in the body trunk or in the artificial cavities are similar, a change of 0.1° in rectal temperature indicates a change of 0.1° in the temperature of the entire body. Our observations, particularly with cold temperature environments, show skin temperatures falling several degrees even when interior body-trunk temperatures may be simultaneously rising slightly. The correction of direct heat measurements by records of the rectal temperature is thus open to grave criticism. Unfortunately no substitute correction can as yet be offered. Secondly, these pronounced differences in skin temperature have great significance in any consideration of the so-called "law of surface area." It is still maintained by many physiologists that, practically independent of species, the heat production of the quiet organism is determined by its surface area. Our observations show clearly that, contrary to popular impression, the temperature of the skin, presumably one of the most important factors affecting heat loss, is very far from uniform, for we have seen that even with well-clothed individuals differences in the temperature of various localities of 4° and 5°C. are of regular occurrence. These observations bring to light and establish one more serious objection to the legality of the conceptions underlying the "body-surface law."

Measuring Visibility.—An article under this title was published in our issue of November 8 on page 279. Through an inadvertency we failed to state that we were indebted to the *Monthly Weather Review* for the article.

Electrical Purification of Clays

THE phenomena known as electrical endosmose and cataphoresis, whereby matter in a very finely divided or colloidal state is capable of being influenced by an electrical potential, have been extensively investigated. For instance, when a colloidal solution of arsenious sulphide is placed in a cell and a direct current at a potential of 100 volts passed from suitable electrodes through the solution, the colloidal particles tend after a time to collect round the positive pole, leaving a clear zone round the negative pole.

It is found that nearly all substances, if in a sufficiently fine state of division, are attracted either to one pole or the other. It has also been observed that aggregates of certain fine particles can be dispersed and separated by adding to the fluid in which they are suspended minute quantities of alkali in the case of those particles attracted to the positive pole, and of acid to those which are attracted to the negative pole. Moreover, if the particles are not sufficiently susceptible to the dispersive effect of the added electrolyte, they can be made so by being allowed to absorb some colloid, such as colloidal silicic acid.

This latter discovery has a most important bearing on the clay industry. China clay and ball clay are examples of such aggregates of fine particles, and if a thick slip is made up of the clay and water the addition of small amounts of alkali causes the clay particles to disperse, and the slip, as a consequence, to become much thinner and more mobile, the clay particles remaining in suspension a considerable time and exhibiting vigorous Brownian movement. On passing a current of electricity through a suspension, the clay particles collect and adhere closely to the anode plate, the water collecting in a zone substantially free from clay, round the cathode. Impurities in the original clay, such as mica, quartz, felspar, and iron compounds, are either unaffected by the electrical potential and settle out, or attracted to the cathode. A means of purifying clay on a commercial scale can thus be evolved from a consideration of the above phenomena, as was shown by the exhibit of raw and purified clays at the recent British Scientific Products Exhibition.

The commercial equipment for such a process consists of a blunger, settling tanks to allow the coarse impurities to settle out of the suspension, and an Osmosis machine composed of a rectangular trough in which is arranged horizontally a cylindrical metal anode surrounded beneath the surface of the slip and at a short distance from it by a cathode through which, by paddles or other means of circulation, the clay slip is driven. The cylinder is made to revolve slowly, and by means of a scraper the dried purified clay, containing 20-30 per cent. of water, is collected.

The machine not merely collects the suspended clay and frees it from water, but subjects the suspension to an electrical purification as well, for should there still be in suspension with the clay minute particles, of mica, iron, and silica that have not had time to settle out in the tank, these are not attracted to the anode, but for the most part remain in the effluent leaving the trough. Consequently, electrically osmosed clay is a purer product than can be obtained by any method of settling or centrifuging.

The improvements effected by the process are:—(1) Pyritic and other forms of uncombined iron are removed. (2) The sintering temperature of the clay is lowered so that a lower kiln-temperature can be employed, with consequent saving of fuel. (3) Clay can be graded into different degrees of fineness. (4) Fireclays can be rendered more plastic and more refractory by this treatment.

Another very important application of cataphoresis is the electrical filter-press. In this press the electrical potential is utilised as a means of driving out the water from suspensions of fine particles; thus, instead of needing pressures running up to 20 atmospheres in some cases where ordinary filtration is used, a head of 14 ft. is ample for the purpose in the electrical filter-press. As an instance of the efficiency and speed with which filtering can be accomplished by such a press, a cake of china clay 4½ in. thick containing 25 per cent. of water can be made in less than two hours.

The applications of electrical endosmose or electrical dialysis in various industries is of importance. Gelatine can be freed from all inorganic mineral matter, so that an ashless gelatine can be obtained of a purity which should be suitable for photographic purposes. There is clear experimental evidence that pure colloidal silicic acid can be prepared from sodium silicate and alumina from sodium aluminate by subjecting their solutions to an electrical potential in cells with suitable diaphragms through which the alkali can migrate. These are a few examples of useful developments, but it is evident that an increasing number of important comercial processes may be expected to arise out of the application of the principles underlying the above phenomena.—From *Nature* (London).

Food Value of Alfalfa Used as a Table Vegetable

(*Concluded from page* 298.)

of the wild plants. The leaves alone are doubtless still richer in albumen. Esparsette (*Onobrychis sativa Lam.*) is possibly also available, although the bast coating of the bundles of vessels in the sprays of leaves are somewhat coarser than in alfalfa. The figures given for the content of nitrogenous substances in the white stone clover (*Melilotus alba L.*) are 3.28 per cent and 5.67 per cent. The horn clover (*Trigonella foenum graecum L.*) is grown in western India, Egypt, the south of France, Thuringia and the Vogtland; in India and Egypt the young sprouts are a much appreciated vegetable. The idea naturally arises, first of all, that the common red or meadow clover (*Trifolium pratense L.*) and its nearest relatives might be used as vegetables, since the area planted with these in the German empire in 1913 was no less than 1,987,000 hectars. However, microscopic examination failed to yield encouraging results. The stalks of the red clover possess strong and well lignified bast coatings in front of the bundles of vessels, while between these are libriform bridges quite as well lignified. In the full grown leaf sprays the secondary nerves of the bundles of vessels are also provided with bast coatings consisting of ten to twelve cells on the average. The palisade layer and the five layered spongy parenchyma are especially rich in chlorophyl. In the younger leaves which still lack their full growth (the length of the leaf stalk being about 2 cm.) whose contents of nitrogenous substances is stated by Dietrich and Koenig to range from 5.85 per cent to 7.19 per cent, the bast coatings of the secondary nerves have already become very thick walls, even though they still remain kollenchymatous in character; even the epidermis is already rather coarsely formed. Accordingly, red clover could only be used as a vegetable if the very young leaves still in the budding stage were selected, which would be a very troublesome and probably also too expensive proceeding.

In my opinion the employment of the leaves of leguminous plants and particularly of alfalfa to furnish a vegetable comparatively rich in protein is advisable not only in war times, but during the coming time of peace.

Coins of the Ages—II.

(*Concluded from page* 310)

broader and thinner than those now made. The reverse is like the next number.

239. The half eagle or $5 gold piece. The reverse only is shown; the obverse is similar to the $10 piece. First coined in 1795.

240. The $2.50 gold piece, showing the second style of reverse. First coined in 1796.

241. The gold dollar, coined from 1849 to 1889. Although about 19,500,000 were made, they were considered too small for actual use, and were used extensively for bangles and jewelry.

242. Our first silver dollar. This has been coined at varying intervals since 1794. It has not been coined since 1904, to the joy of most people.

243. The trade dollar, made primarily for export to the Orient to compete with the Spanish-American and Mexican pesos. As we did not take the Chinamen into our confidence as regards the design or our intentions, it turned out a failure. It is the only demonetized coin of the United States.

244. The reverse of the Gobrecht dollar. This piece was named after the designer and, like the majority of our best coin designs, never emerged from the experimental or trial stage.

245. The 1804 dollar. More fable and fiction has grown up around this dollar than any other of our coins on account of its great rarity. It is very doubtful if any were made in 1804.

246. An old type quarter, showing the third style of head used on our silver coins.

247. The reverse of the 20 cent piece, only issued for four years in the '70s.

248. The old five-cent silver piece, coined from 1794 to 1873. Our nickel now takes its place, which is our most convenient size of coin.

249. The Isabella quarter dollar issued during the World's Columbian Exposition.

250. Obverse and reverse of the silver three cent piece, another discontinued coin.

251. The fourth type of our silver coinage.

252. The bronze two cent piece, another coin of the past.

253. The half cent coined from 1793 to 1857. The revival of this denomination has often been agitated. Nearly all other nations issue coins of less value than our cent.

254. The reverse of our first cent, with a chain of thirteen links. These large copper cents were coined from 1793 to 1857, when they were superseded by our present size of cent.

255-258. Various types of our earliest cents. No. 257 is the rare 1804 cent.

259. The flying eagle or buzzard cent, copied from the dollar, No. 244. This was made of a whitish alloy of copper, known as copper nickel.

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Table of Contents PAGE

Food Value of Alfalfa Used as a Table Vegetable by Dr. G. Haberlandt 298
Rhythmis Chrystalization—by Raphael Ed. Liesegang.. 299
New Glow-Lamp 299
Battery-Propelled Fishing Vessels 299
The Dome of the Rock —Illustrated 300
Animal Spies—by K. Ishikawa 300
Time Relations in a Dream 301
The Navigational Compass—by M. B. Field, O.B.E.—Illustrated 302
Lead Pencil Manufacture 303
Tobacco-Growing in Cuba—by T. C. Francis—Illustrated 304
Future of the Draft Horse—by Mayne Dinsmore..... 306
Street Lighting and Traffic Accidents—by Ward Harrison 307
Coins of the Ages—II—by Howard Wood—Illustrated.. 308
Temperature of the Human Skin—by F. G. Benedict, W. R. Miles and Silas Johnson—Illustrated..... 311
Electrical Purification of Clays 312

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PAGE

298
299
299
299
300
300
301

302
303
304
306
307
308

311
312